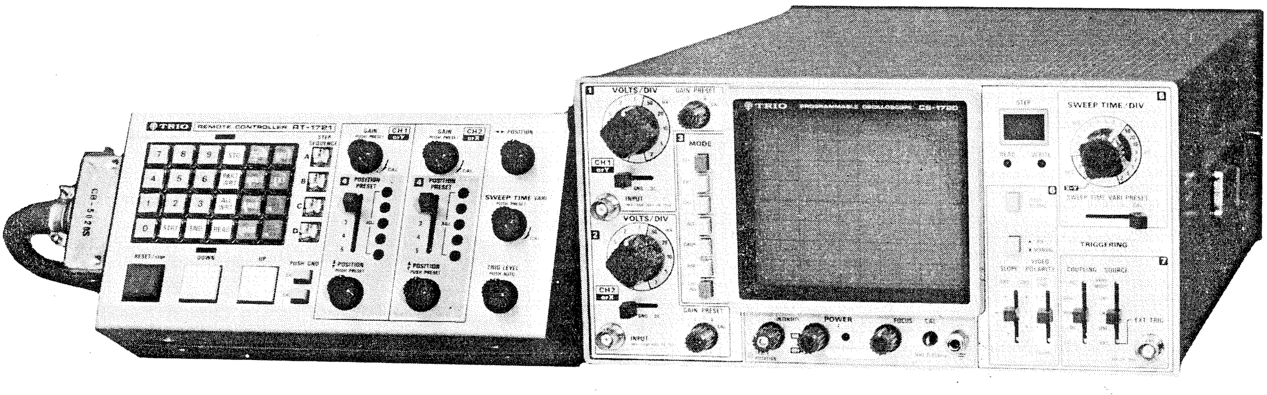
Kenwood

# CS-1720

## 20 MHz DUAL TRACE
## PROGRAMMABLE OSCILLOSCOPE

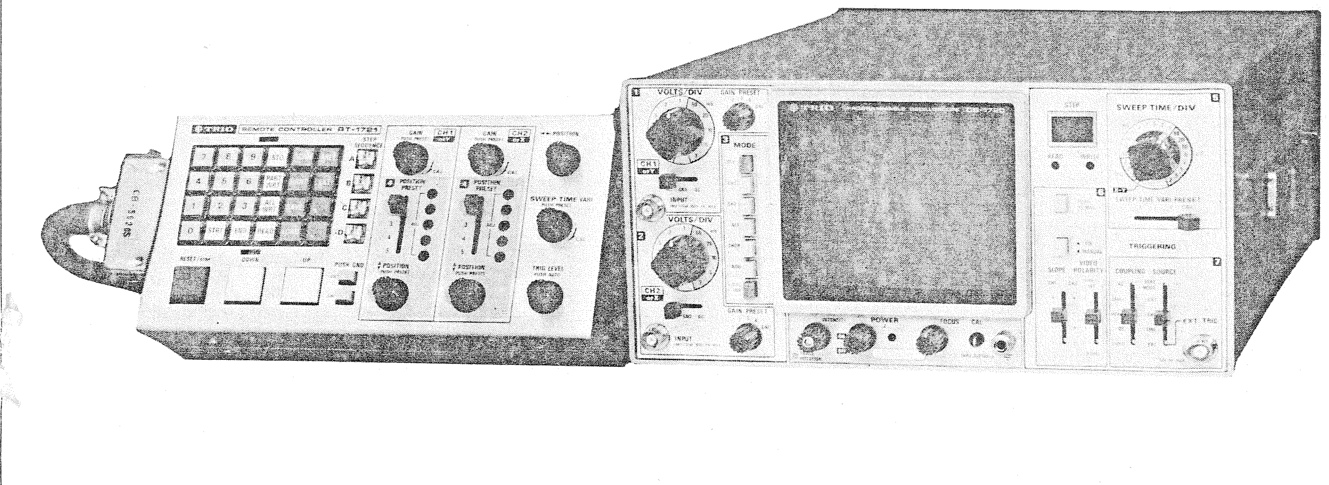
OPTION

RT-1721 MT-1725


TRIO REMOTE CONTROLLER RT-1721
TRIO PROGRAMMABLE OSCILLOSCOPE CS-1720
VOLTS/DIV
MODE
SWEEP TIME/DIV
TRIGGERING
POWER

TRIO

# SERVICE MANUAL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# GENERAL INTRODUCTION

The CS-1720 is a dual-trace programmable oscilloscope, with up to 62 main programme functions settings programmable beforehand. With such prior programming, great energy savings are possible in the manufacturing process, as the oscilloscope can be operated with simple key controls. In addition to the programmed operation, it is possible to use the CS-1720 as a normal manually controlled scope by switching it over to the FREE position. The function of the oscilloscope is further increased with optional accessory units: the probe selector, which gives 20 possible signal channels; the memory pack, which can transfer and retain the programme contents; and the printer which can produce a hard copy of the programme data. Remote control test fixture of the production line, and computer control are also possible.

# FEATURES

- The microprocessor: programmes with a maximum of 62 steps can be stored in the oscilloscope memory.
- Programming and waveform measuring conditions are easily programmed by panel control with one-touch key operations.
- Parts of the programme can be easily corrected using the clearly laid out function control panel.
- A maximum of 62 steps (00-61) can be directly set with the key board, and sequentially set with the UP/DOWN keys.
- The programme contents have a battery powered back-up system, and are able to be retained in the memory for a long time, even though the POWER switch is off.
- One-touch operation converts the oscilloscope to manual control, when it functions as a normal oscilloscope.
- Presetting of four start (A, B, C, D) and stop steps is possible, so only one-touch operation is necessary to change steps.
- 2 mV/div and 20 MHz gives an oscilloscope of high sensitivity, with a wide bandwidth, and at the same time light and compact.
- The 140 mm rectangular CRT has internal graticule with 8 x 10 divisions, post deflection acceleration, and high trace intensity.
- Vertical and horizontal positioning, variable gain and trig level by remote operation are possible
- As push GND remote operation is possible on CH1 and CH2, the reference level can be easily and accurately calibrated at hand.
- VIDEO FRAME/LINE sync circuit permits to observe both easy and stable VIDEO signal.
- Observation of VIDEO signal in different fields can be carried out simultaneously using the one input signal, dual trace by SEP function.
- CH1/CH2 independent TRIG SLOPE system is provided.
- As CH1 monitor output can be achieved, a frequency counter or similar instrument can be easily connected.
- Memory back-up, down-warning system is provided.

## OPTIONAL ACCESSORIES

- By using the probe selector, either 5 types of input signal change-over (RU-1722) per channel, or 10 types (RU-1723) can be programmed.
- By using the thermal printer (TP-1724), a hard copy of the programme contents can be made.
- By using the memory pack (MT-1725), the programme contents for up to 62 steps can be transferred from the oscilloscope to the memory pack or vice versa, and the data can be retained for a long period of time.
- SWEET OUT and SWEEP GATE output terminals are optional.
- The interface unit of the external control unit can be matched.

# SPECIFICATIONS

## CS-1720 PROGRAMMABLE OSCILLOSCOPE

### CATHODE RAY TUBE (CRT)

| | |
|---|---|
| Model | 140CGB31 |
| Type | Rectangular with internal graticule. |
| Acceleration voltage | 6 kV |
| Display area | 8 x 10 divisions<br>(1 div=9.5 mm) |

### VERTICAL AXIS (CH1, CH2,)

| | |
|---|---|
| Sensitivity | 2 mV/div — 5 V/div |
| Accuracy | ±5% |
| Attenuator | 2 mV/div — 5 V/div 1-2-5 sequence.<br>Fine adjustment possible between all ranges; remote controller (RT-1721), CAL and 4 range presets with vernier adjustment are possible. |
| Input resistance | 1 MΩ±5% |
| Input capacity | 37 pF±3 pF |
| Input coupling | AC-GND-DC |
| Frequency response | |
| DC | DC — 20 MHz (−3 dB)<br>DC — 30 MHz (−6 dB) |
| AC | 5 Hz — 20 MHz (−3 dB)<br>5 Hz — 30 MHz (−6 dB) |
| Risetime | Better than 17.5 ns |
| Signal delay time | More than 10 ns on the screen. |
| Crosstalk | −40 dB or better, at 1 kHz |
| Operating modes | |
| CH1 | CH1 only, single trace |
| CH2 | CH2 only, single trace |
| ALT | CH1, CH2 dual trace, alternate mode |
| CHOP | CH1, CH2 dual trace, chop mode |
| ADD | Single trace algebraic sum of CH1 and CH2 |
| CH2 INV | CH2 inverted polarity, CH1 minus CH2, single trace |
| SEP | CH1 or CH2, one input signal, dual trace, alternate |
| Chop frequency | Approx 200 kHz |
| Maximum input voltages | 200 V p-p or 100 V (DC+AC peak) |
| Maximum undistorted amplitude | 8 div. minimum from DC — 20 MHz |

### HORIZONTAL AXIS (CH2 INPUT)

| | |
|---|---|
| Operating modes | SWEEP TIME/DIV range can be selected to X — Y mode.<br>CH1 — Y axis: CH2 — X axis |
| Sensitivity | Same as CH2 vertical axis |
| Accuracy | Same as CH2 vertical axis |
| Attenuation | Same as CH2 vertical axis |
| Input resistance | Same as CH2 vertical axis |
| Input capacity | Same as CH2 vertical axis |
| Input coupling | Same as CH2 vertical axis |
| Frequency response | |
| DC: | DC — 2 MHz (−3 dB) |
| AC: | 5 Hz — 2 MHz (−3 dB) |
| X — Y phase difference | Within 3° at 100 kHz |

### SWEEP CIRCUITS

| | |
|---|---|
| Sweep system | |
| NORM | Triggering sweep (remote controller RT-1721) |
| AUTO | Triggering sweep and auto free run sweep in absence of trigger signal (with RT-1721) |
| Sweep time | 0.2 μs/div — 0.5s/div 1-2-5 sequence, with vernier control fine adjustment between all 20 ranges (with remote controller RT-1721); CAL and 3 range presets with vernier adjustment are possible. |
| Accuracy | ±5% |
| Sweep magnification | X5 (five times) ±5% |
| Linearity | 3% or better at normal, 5% or better at X5 magnification |

### TRIGGERING

| | |
|---|---|
| Source | VERT MODE, CH1, CH2, LINE, EXT. |
| Coupling mode | AC, LFREJ, HFREJ, DC, VIDEO. |
| Video polarity | VIDEO (+/−); FRAME (+/−) |
| Triggering mode | MANUAL, FIX (automatically fixes level at center of trigger source). |
| Sync polarity | CH1/CH2<br>(+/+, +/−, −/+, −/−) |
| External sync | EXT |
| Input resistance | 1 MΩ±5% |
| Input capacity | 40 pF±5 pF |
| Maximum input voltage | 100 Vp-p, or 50 V (DC+AC peak) |

# SPECIFICATIONS

**Trigger sensitivity**

| Coupling | Frequency range (Hz) | Minimum Sync Voltage | |
|---|---|---|---|
| | | INT | EXT |
| AC | 10~20 MHz<br>20~15 MHz | 1 div.<br>0.5 div. | 1.0 V<br>0.5 V |
| AC (LFREJ) | Below 30 kHz the minimum sync amplitude (voltage) will increase. | | |
| AC (HFREJ) | The range below 20 Hz and above 30 kHz the minimum sync amplitude (voltage) will increase. | | |
| DC | DC – 20 MHz<br>DC – 15 MHz | 1 div.<br>0.5 div. | 1.0 V<br>0.5 V |
| VIDEO | VIDEO SYNC LEVEL | 0.5 div. | 0.5 V |

| | |
|---|---|
| AUTO: | Same as above specifications for above 20 Hz |
| FIX: | 20 Hz – 20 MHz, 1 div. (1.0 V) |
| Calibration voltage | Square wave, positive polarity<br>0.1 V ±2%<br>1 kHz ±5% |

## INTENSITY MODULATION

| | |
|---|---|
| Input voltage | In TTL level intensity modulation is possible. (More positive levels increase the intensity). |
| Input impedance | Approx. 10 kΩ |
| Usable frequency range | DC – 5 MHz |
| Maximum input voltage | ±50 V (DC+AC peak) |

## VERTICAL AXIS SIGNAL OUTPUT (Signal Output of CH1)

| | |
|---|---|
| Output voltage | 100 mV p-p/div minimum, at 1 kHz |
| Output impedance | Approx 50 Ω |
| Frequency response | 10 Hz – 20 MHz (–3 dB) (50 Ω load) |

## SWEEP OUTPUT (Optional)

| | |
|---|---|
| Output voltage | More than 1 V p-p (50 Ω load) |
| Output impedance | Approx 50 Ω |

## GATE OUTPUT (Optional)

| | |
|---|---|
| Output voltage | TTL output, series resistance 220 Ω negative logic (during sweep operation, low level) |

## TRACE ROTATION

Trace angle is possible by trace rotation control on the front panel.

## PROGRAMME STATES

| | |
|---|---|
| Programme items | 8 blocks, 24 items |
| 1 block (CH1) | |
| Input coupling | AC/DC |
| Vertical sensitivity | 2 mV/div – 5 V/div (11 ranges) CAL and 4 presets with vernier adjustment are provided. |
| 2 block (CH2) | |
| Input coupling | AC/DC |
| Vertical sensitivity | 2 mV/div – 5 V/div (11 ranges) CAL and 4 presets with vernier adjustment are provided. |
| 3 block | |
| Separate | SEP (CH1/CH2) |
| Operating mode | CH1, CH2, ALT, CHOP, ADD |
| Polarity inversion | CH2 INV |
| 4 block | |
| Vertical position | CH1: 5 point presets (more than ±4 div adjustable). |
| Vertical position | CH2: 5 point presets (more than ±4 div adjustable). |
| 5 block | |
| Sweep time | 0.2 μs/div – 0.5 s/div (20 ranges)<br>CAL and 3 range presets with vernier fine adjustment. |
| X-Y operation | X-Y, 1 range. |
| 6 block | |
| Sweep magnification | X5 (five times) MAG |
| Triggering mode | MANUAL/FIX |
| Sync polarity | CH1/CH2 (+/+, +/–, –/+, –/–) |
| VIDEO polarity | VIDEO (+/–); FRAME (+/–) |
| 7 block | |
| SOURCE | V MODE, CH1, CH2, LINE, EXT |
| Coupling | AC, LFREJ, HFREJ, DC, VIDEO |
| EXT trigger input | OFF, 1 2 3 (RU-1722, RU-1723) |
| 8 block | |
| Input signal changeover (CH1) | 1 – 5 (RU-1722)<br>1 – 10 (RU-1723) |
| Input signal changeover (CH2) | 1 – 5 (RU-1722)<br>1 – 10 (RU-1723) |
| Remote | Step sequence: A, B, C, D. Start step, end step, 4 kinds of each. |

## PROGRAMME CONTROL FUNCTIONS

| | |
|---|---|
| Control method | Microprocessor control |
| Memory | CMOS, RAM, with battery |
| Steps | 62 steps (00 – 61) |
| Operation | Key operation (remote controller RT-1721) |
| Indication | STEP NO., 2 figures, 7 segments<br>READ: green LED<br>WRITE: red LED<br>PART WRT: green & red LEDs |

# SPECIFICATIONS

| | |
|---|---|
| Protective circuitry | Low battery level indication is provided. (7 segments flash on)<br>Memory pack: misconnection avoidance function is provided (no operation).<br>Printer: misconnection avoidance function is provided: warning alarm will sound. |

### OPTIONAL EXTERNAL ACCESSORIES

Probe selector, RU-1722
(CH1 × 5 & CH2 × 5, EXT × 3)
Probe selector, RU-1723
(CH1 × 10 or CH2 × 10, EXT × 3)
Thermal printer TP-1724
Memory pack MT-1725
It is possible to expand the function of the oscilloscope with external control.

### POWER SUPPLY

| | |
|---|---|
| Voltage | Low: 90 V – 132 V<br>High: 180 V – 264 V |
| Frequency | 50/60 Hz |
| Power consumption | Approx 43 W |

### DIMENSIONS

| | |
|---|---|
| Width | 284 (312) mm |
| Height | 138 (150) mm |
| Length | 400 (450) mm<br>The dimensions in brackets are including fittings. |

| | |
|---|---|
| **WEIGHT** | 7.1 kg |
| **ACCESSORIES** | Probes; 2 pieces (PC-29)<br>Instruction manual; 1 copy.<br>AC power cable: 1 piece |

### OPERATING ENVIRONMENT

| | |
|---|---|
| Optimum temperature and humidity: | 10°C – 35°C 85% RH or less |
| Operating temperature and humidity: | 0°C – 50°C, 90% RH or less |
| Storage temperature and humidity: | –20°C – 55°C, 80% RH or less |

### OPTIONAL ACCESSORIES

Remote controller; RT-1721
Probe selector, (5 inputs × 2 channel); RU-1722
Probe selector, (10 inputs × 1 channel); RU-1723
Thermal printer; TP-1724
Memory pack: MT-1725

## RT-1721 REMOTE CONTROLLER (OPTION)

### REMOTE OPERATION SECTION

VERTICAL AXIS (CH1, CH2)

| | |
|---|---|
| Variable attenuation | Vernier fine adjustment between all ranges of VOLTS/DIV control on CS-1720 is possible, in addition to preset change-over. |
| Position adjustment | 5 Presets, more than ± 4 div. adjustable.<br>Vernier fine adjustment: more than ± 2 div adjustable. |
| Input coupling | Push GND, CH1/CH2 |
| Horizontal position adjustment | More than ± 5 div adjustable. |
| Sweep time variable | Vernier fine adjustment between all ranges of SWEEP TIME/DIV control on CS-1720 is possible, in addition to preset change-over. |
| Sweep mode | NORM/AUTO |
| Trigger level | More than ± 4 div |

### PROGRAMME OPERATION SECTION

| | |
|---|---|
| Programme console keys | 29 types. |

### DIMENSIONS

| | |
|---|---|
| Width | 230 (290) mm |
| Height | 55 (69) mm |
| Length | 115 (120) mm<br>Dimensions in brackets are with fittings. |

| | |
|---|---|
| **WEIGHT** | 1.2 kg |
| **ACCESSORY** | Connecting cable CB-5020S |

### OPERATING ENVIRONMENT

Same as oscilloscope CS-1720

## MT-1725 MEMORY PACK (OPTION)

| | |
|---|---|
| **Memory** | CMOS RAM 1K×4 BIT with backup with a lithium battery. |
| **Battery low level level indication** | When the MT-1725 is connected to the CS-1720, the voltage level of the battery is automatically checked. If it is too low the 7 segment LEDs of the STEP indicator will flash on and off. |
| **Detector voltage** | Approx. 2.5 V |

# PRECAUTIONS

**Battery replacement**

Remove 2 screws holding the case at the connector side and slide the case forward. Check the level of disc type lithium battery in the printed circuit board. If the level is below 2.5 V, replace the battery. In this case, observe the polarity.

> **NOTE**
>
> In order to avoid damage of the stored data, make sure the power switch of the CS-1720 is set to OFF when connecting the MT-1725 memory pack, or disconnecting it. As the memory pack contains its own backup battery, avoid any sudden shocks or high temperature and humidity.

| | |
|---|---|
| **Operating environment** | Temp: 5°C − 40°C,<br>Hum: Less than 80% RH |
| **Storing environment** | Temp: −20°C − 55°C,<br>Hum: Less than 85% RH<br>(Avoid excess condensation) |
| **Dimensions** | Width 57 mm<br>Height 26 mm<br>Length 92 mm (104 mm*)<br>*The dimensions in brackets are with fittings. |
| **Weight** | 110 g |

■ Circuit and rating are subject to change without notice due to developments in technology.

## PRECAUTIONS

> NOTE
>
> Before using the oscilloscope CS-1720, check the power supply voltage, and make sure that the voltage selector switch is correctly set to the corresponding voltage. If the control is incorrectly set, damage to the electric circuits will occur, so check carefully. After checking that the power supply voltage and the voltage selector switch correspond, connect the CS-1720 oscilloscope to a suitable socket using the AC power cord.

1) **Do not switch the power switch on and off rapidly in succession, as this may cause it to malfunction. Allow at least 3 seconds between switching on and switching off.**
2) **When connecting or disconnecting any of the optional accessories, the power must be OFF.**
3) Avoid using the CS-1720 under the following conditions:
   a) In direct sunlight.
   b) In a room with high temperature and humidity.
   c) In a room affected by vibration from nearby machinery.
   d) Near any high voltage instrument, or one with a strong magnetic field.
4) Ensure that the voltage at each input terminal does not exceed the maximum rating.

   CH1, CH2 input: Refer to specifications
   EXT TRIG input: Refer to specifications
   Z AXIS input: Refer to specifications

   Do not connect any of the output terminals to an external signal source.

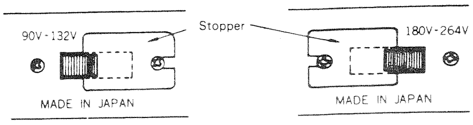


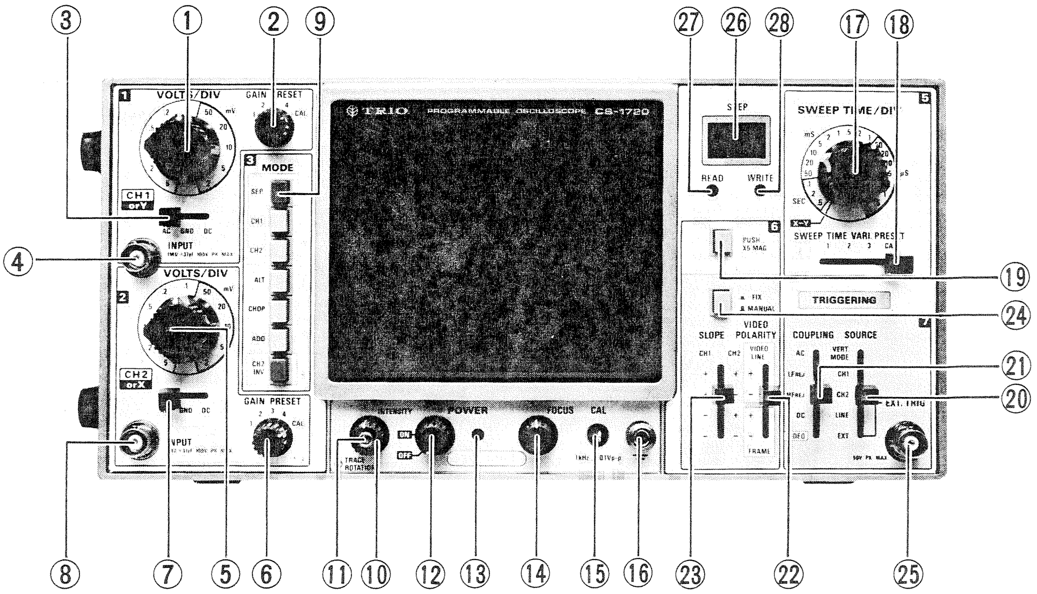
Fig. 3-1

5) Keep the brightness control to the necessary minimum.
6) Do not leave the CS-1720 for any length of time with a stationary spot displayed on the screen.
7) The CS-1720 uses a backup battery system for the programme data. When the battery level is getting low, the STEP LED will flash when the power is switched on. In this event, replace the batteries, referring to the appropriate section in the maintenance instructions.
8) To avoid possible electric shocks, ensure the earth terminal is properly connected. (See front panel ⏚ (16) for explanation and instructions)
9) Be sure that no objects are allowed to rest on the top of the unit or that cooling vents are not blocked, since this will cause an undue temperature rise.
10) Before removing the case, be sure to turn off the power. Since the CS-1720 makes use of high voltage circuitry, if removing the case, refer to the "MAINTENANCE" for removing the case.
11) Setting the AC voltage selector.
    1) Loosen the screw and remove the stopper plate.
    2) Switch the lever to the opposite side.
    3) Lock the lever by attaching the stopper plate to the opposite side and tight the two screws.
12) Cascade connection must not be made. Never make cascade connection with CH1 output to the CH2 input or EXT input.
13) Never connect CH1 or CH2 input in parallel with EXT input.
14) In order to obtain accurate measurements, it is most important to calibrate the probe correctly before using the oscilloscope. First, connect the probe to the channel to be used, and connect the tip of the probe to the CAL terminal on the front panel. Adjust the probe trimmer pot to get the proper square waveform on the CRT screen. When connecting the probe to the CAL terminal, be sure always to connect it together with the GND terminal. When the GND terminal is in an open condition, signal noise will accompany the waveform.

# CONTROLS AND INDICATORS

## PROGRAMMABLE OSCILLOSCOPE CS-1720

<FRONT PANEL>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TRIO PROGRAMMABLE OSCILLOSCOPE CS-1720
VOLTS/DIV
GAIN PRESET
CH1 or Y
INPUT
MODE
CH2 or X
POWER
FOCUS
CAL
STEP
READ
WRITE
SWEEP TIME/DIV
SWEEP TIME VARI PRESET
TRIGGERING
SLOPE
VIDEO POLARITY
COUPLING
SOURCE
EXT. TRIG

Fig. 4-1

**(1) VOLTS/DIV**

Vertical attenuator calibrated in voltage per division, in 1-2-5 sequence, and adjustment will give the optimum waveform. The vertical sensitivity is calibrated at GAIN CAL position. When the oscilloscope is being used as an X-Y scope, this control serves as the Y-axis control.

**(2) GAIN PRESET**

Vertical attenuation adjuster and preset selector; change-over of 4 preset ranges and CAL, set by the vertical attenuation adjustment control (29). This selector is calibrated in the CAL position. In X-Y scope this control is the Y-axis preset selector.

**(3) AC-GND-DC**

Vertical input selector switch for CH1. In X-Y operation, the Y axis-input selector switch.

**AC:** The DC component of the input signal is blocked.

**GND:** Opens signal path and ground input to vetical amplifier. This provides a zero signal base line.

**DC:** Direct input of both AC and DC components of input signal.

**(4) INPUT**

Vertical input terminal for CH1. During X-Y operation, the Y-axis input.

**(5) VOLTS/DIV**

Vertical attenuator for CH2, having the same function as CH1 VOLTS/DIV (1). During X-Y operation, the X-axis attenuator.

**(6) GAIN PRESET**

CH2 vertical attenuator adjuster and preset selector. Has the same function as CH1 GAIN PRESET (2). In X-Y operation, the X-axis preset attenuation selector.

**(7) AC-GND-DC**

CH2 vertical input selector. In X-Y operation, the X-axis input selector switch. It has the same function as CH1 AC-GND-DC (3).

**(8) INPUT**

CH2 vertical input. In X-Y operation, the X-axis input terminal.

**(9) MODE**

Selects the operating mode of the vertical axis.

**CH1:** CH1 input signal is displayed on the CRT screen.

**CH2:** CH2 input signal is displayed on the CRT screen.

**ALT:** CH1 and CH2 signals are displayed alternately.

**CHOP:** CH1 and CH2 signals are displayed in chopping mode.

**ADD:** The algebraic sum of CH1 and CH2 is

# CONTROLS AND INDICATORS

displayed, in single trace. When CH2 INV is set, the difference is displayed in single trace.

**CH2 INV:** The polarity of CH2 signal is reversed.

**SEP:** CH1 input signal is alternately displayed in both ''main'' and ''sub''. Refer to SEPARATE PRESET (30) instructions.
In CH2, CH2 input signal is displayed as same function as CH1 SEP operation.

> **NOTE**
> The various vertical mode are related to trigger source. Refer to SOURCE (20) instructions.

**(10) INTENSITY**

Adjusts the brightness of the trace, with outside axis control. Clockwise rotation increases brightness.

**(11) TRACE ROTATION**

Adjusts the angle of the horizontal trace.

**(12) POWER**

Switches on or off the power to the CS-1720. When connecting or disconnecting any of the optional accessories be sure the power switch is in the OFF position.

**(13) PILOT LAMP**

When lit, indicates power is ON.

**(14) FOCUS**

Adjusts the focus of the trace. As the CS-1720 uses an auto focus circuit, once this control is adjusted, it need not frequently to be readjusted.

**(15) CAL**

Provides 0.1 V peak to peak square wave input signal at 1 kHz.

**(16) ⏚ GND**

The ground terminal used to earth the oscilloscope chassis and body as an aid against electrical shocks.

**(17) SWEEP TIME/DIV**

Horizontal sweep time control. It selects sweep times from 0.2 $\mu$s/div — 0.5 s/div in 20 ranges in 1-2-5 sequence. In addition, full counter-clockwise rotation energises X-Y scope operation.

**(18) SWEEP TIME VARI PRESET**

This control is a fine adjuster and preset for sweep time. It can select three range presets and CAL set by SWEEP TIME VARI PRESET (36). Sweep time is calibrated in CAL position.

**(19) PUSH X5 MAG**

When this control is pushed in (■) position, the sweep time is made 5 times faster per division. With the button in (▬) position, mormal sweep time is resumed.

**(20) SOURCE**

Selects sweep trigger source.

**VERT MODE:** Trigger signal is selected by setting vertical mode.

| | |
|---|---|
| CH1 | CH1 signal becomes trigger source |
| CH2 | CH2 signal becomes trigger source |
| ALT | For CH1, CH1 signal becomes trigger source<br>For CH2, CH2 signal becomes trigger source. |
| CHOP | CHOP change-over signal becomes trigger source |
| ADD | Algebraic sum of CH1 & CH2 signals becomes trigger source |

**CH1:** CH1 signal becomes trigger source.

**CH2:** CH2 signal becomes trigger source.

**LINE:** The power source frequency signal becomes trigger source.

**EXT:** The signal applied to EXT TRIG (25) becomes trigger source.

> **NOTE**
> 1) When the vertical axis mode is set in ALT, in VIDEO FRAME (22) CH1 signal will be fixed to trigger source.
> 2) When the vertical axis mode is set in CHOP, as the CHOP change-over signal becomes the trigger source, stable display cannot be observed. Therefore in this instance, select proper trigger signal, excluding VERT MODE.

**(21) COUPLING**

Controls the coupled trigger signal

**AC:** Trigger signal is AC coupled, excluding DC components.

**LFREJ:** Trigger signal is coupled to sync circuit through high pass filter. All low frequency components are attenuated.

**HFREJ:** Trigger signal is coupled to sync circuit through low pass filter. All high frequency components are attenuated.

**DC:** Trigger singal is DC coupled, and is coupled to sync circuit, including DC components.

**VIDEO:** For video sync signal. In this case if VIDEO POLARITY switch (22) is set to VIDEO LINE or FRAME, horizontal sync (TV. H) or vertical sync (TV. V) can be selected for synchronization.

**(22) VIDEO POLARITY**

Select polarity of video snyc signal.

**VIDEO LINE:** Sweep is triggered on horizontal sync signal in video signal. At this time, + or − polarity should be selected.

+: For positive polarity sync signal (sync signal is up side of the VIDEO signal)

−: For negative polarity sync signal (sync signal is down side of the VIDEO signal)

**VIDEO FRAME:** Sweep is triggered on vertical sync signal in VIDEO signal.

+: For positive polarity sync signal (Sync signal is up side of the VIDEO signal)

−: For negative polarity sync signal (Sync signal is down side of the VIDEO signal)

**NOTE**

As the 1/2 divider circuit is provided in the VIDEO FRAME synchronizing circuit, odd or even field can be selected by the SLOPE (23) selector switch; refer to VIDEO SYNC in OPERATION instruction.

**(23) SLOPE**

Sync polarity selector switch. Also odd or even field selector when VIDEO FRAME is set.

**CH1:** CH1 sync polarity change-over.

+: Sweep is triggered on rising slope of waveform.

−: Sweep is triggered on falling slope of waveform.

**CH2:** CH2 sync polarity change-over.

+: Sweep is triggered on rising slope of waveform.

−: Sweep is triggered on falling slope of waveform.

**NOTE**

For SLOPE the polarity of CH1 +/− and CH2 +/− is changed over according to the sync signal selected on SOURCE (20). However, since some connections exist with MODE and VIDEO FRAME, refer to the OPERATION instructions.

**(24) FIX/MANUAL**

**FIX (▬):** Automatic triggering level control. Sync is obtained without connection with TRIG LEVEL (60).

**MANUAL (■):** Triggering level can be adjusted by TRIG LEVEL (60).

**NOTE**

When TRIG LEVEL (60) is pulled out (PULL NORM), FIX operation is automatically cancelled, and manual operation is selected.

**(25) EXT TRIG**

External trigger input terminal. If SOURCE (20) switch has been set to EXT, the signal at this input becomes the trigger source.

**(26) STEP**

Programme step number indicator. Step number can be indicated from 00 to 61 as 2 figures of seven segments. When PART WRT is selected numbers from 1 to 8 can be indicated in single figures. This is also used as the battery low level warning indicator which will flash when the internal memory back-up battery is below its operational level.

**NOTE**

Step numbers from 00 to 99 can be indicated. However, if 62 or over is indicated, the indicator will flash once, and the step will have no effect.

**(27) READ**

Green LED indicates programme data are being read out. At the time of PART WRT it will light up together with the WRITE LED (28).

**(28) WRITE**

Red LED indicates input signal is being written in the memory. When PART WRT is set, it will light up together with the READ LED (27).

**<LEFT SIDE>**

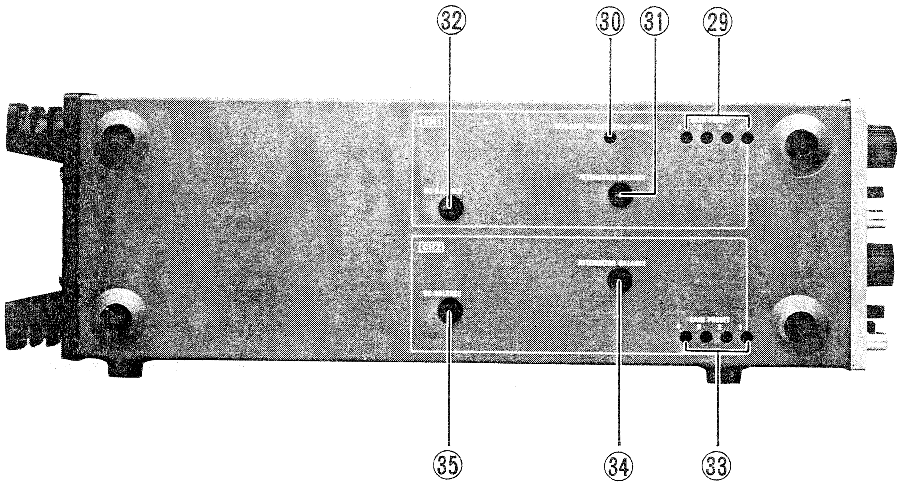


Fig. 4-2

**(29) GAIN PRESET**

Fine adjustment control CH1 vertical attenuation for preset. 4 preset gains can be set and selected by GAIN PRESET (2).

**(30) SEPARATE PRESET (CH1/CH2)**

Vertical position adjustment for sub-sweep preset when SEP (9) in vertical axis mode is selected. Preset adjustment is possible within ±4 div from the main

# CONTROLS AND INDICATORS

vertical sweep position. The preset distance will not change despite changing ▲▼ POSITION controls (52/53, 55/56).

**(31) ATTENUATOR BALANCE**
Vertical DC balance control for CH1 or Y. When turning VOLTS/DIV (1) adjust this control so the trace does not shift vertically.

**(32) DC BALANCE**
Vertical DC balance control for CH1 or Y. When the GAIN (51) control of the vertical amplifier is being turned, DC balance should also be adjusted to fix the trace position. This adjustment should be carried out after having set ATTENUATOR BALANCE (31) correctly.

**(33) GAIN PRESET**
Fine adjustment control for preset of CH2 vertical attenuation. Four preset gains can be set and selected by GAIN PRESET (6).

**(34) ATTENUATOR BALANCE**
Vertical DC balance control for CH2 or X. When being turned the VOLTS/DIV (5), adjust so the trace does not shift vertically.

**(35) DC BALANCE**
Vertical DC balance control for CH2 or X. When the GAIN (54) control of the vertical amplifier is being turned, DC balance should be adjusted to fix the trace position. This adjustment should be carried out after having set ATTENUATOR BALANCE (34) correctly.

**<RIGHT SIDE>**

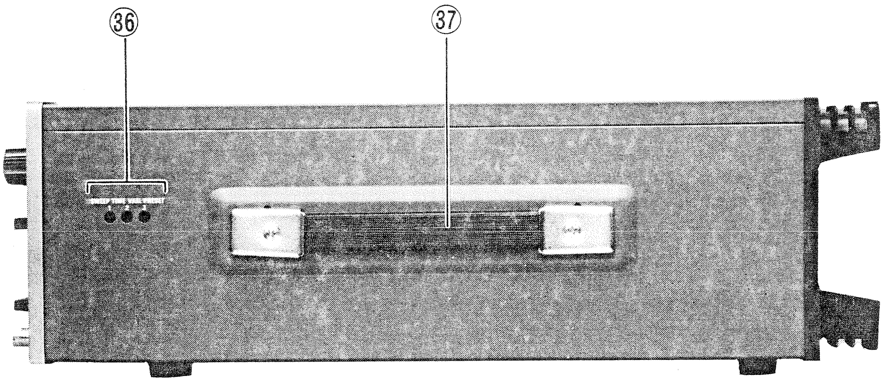
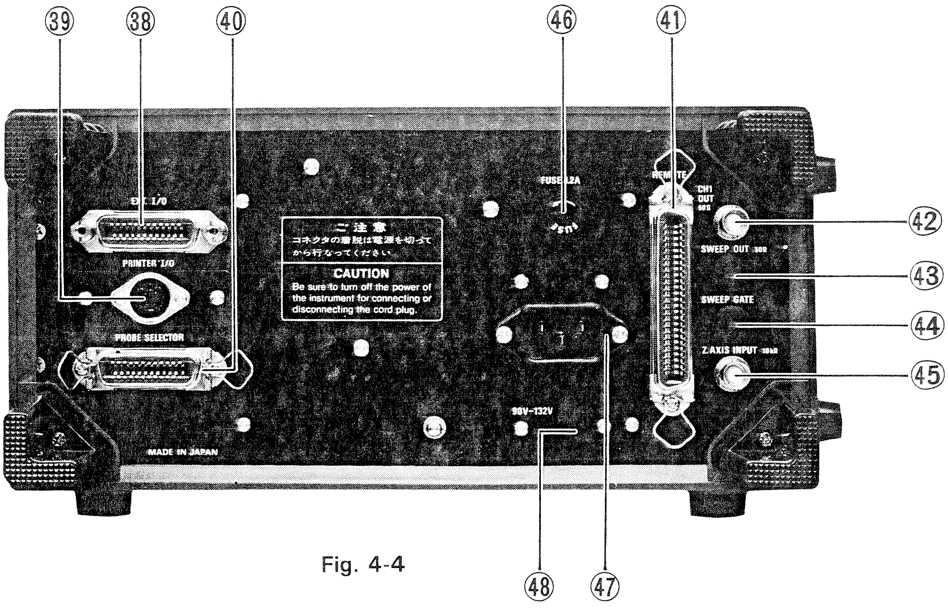


Fig. 4-3

**(36) SWEEP TIME VARI PRESET**
Control for fine adjustment of preset time base. Changes between ranges of SWEEP TIME/DIV continuously. Ranges can be set and selected by SWEEP TIME VARI PRESET (18).

**(37) CARRYING HANDLE**
The oscilloscope should be carried using this handle.

**<REAR PANEL>**


㊴
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㊶
EXT. I/O
PRINTER I/O
PROBE SELECTOR
ご注意
コネクタの着脱は電源を切ってから行なってください
CAUTION
Be sure to turn off the power of the instrument for connecting or disconnecting the cord plug.
FUSE 2A
REMOTE
CH1 OUT 50Ω
SWEEP OUT 50Ω
SWEEP GATE
Z.AXIS INPUT 10kΩ
90V~132V
MADE IN JAPAN
㊷
㊸
㊹
㊺
㊽
㊼

Fig. 4-4

# CONTROLS AND INDICATORS

(38) **EXT I/O**
Connecting socket for optional memory pack (MT-1725) and the other external unit.

(39) **PRINTER I/O**
Connecting socket for optional printer (TP-1724).

(40) **PROBE SELECTOR**
Connector for optional probe selector (RU-1722, RU-1723).

(41) **REMOTE**
Connector for optional remote controller (RT-1721).

> **NOTE**
> When connecting or disconnecting any of the above accessories (38), (39), (40), (41), ensure the power switch is in the OFF position.

(42) **CH1 OUT**
Vertical signal output terminal of CH1.

(43) **SWEEP OUT (OPTIONAL)**
Mounting point for output terminal of sweep signal.

(44) **SWEEP GATE (OPTIONAL)**
Mounting point for output terminal of sweep gate signal.

(45) **Z-AXIS INPUT**
Intensity modulation terminal. Intensity is modulated at TTL level.

(46) **FUSE HOLDER**
Carries 1.2 A fuse.

(47) **POWER SOURCE CONNECTOR**
Connector for AC power input cable. Center pin of three-wire cord is ground terminal.

(48) **POWER SUPPLY SELECTOR SWITCH**
This switch must be adjusted according to the available AC power.
**LOW:** 90 V – 132 V; **HIGH:** 180 V – 264 V.

<BOTTOM>

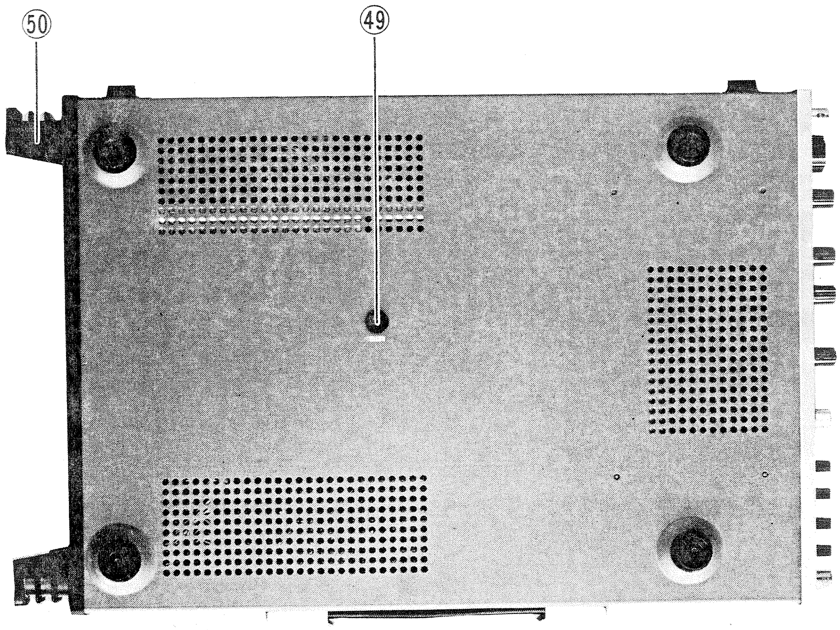


Fig. 4-5

(49) **ASTIG**
Trace or spot astigmatism compensation control. Once adjusted, this control does not need frequent readjustment.

(50) **FEET/CABLE WRAP**
When the CS-1720 is used upright (vertically), these mouldings act as feet. The AC power cable can also be wrapped around them when the CS-1720 is not in use.

# CONTROLS AND INDICATORS

## REMOTE CONTROLLER: RT-1721 (OPTION)

### < REMOTE OPERATION SECTION >

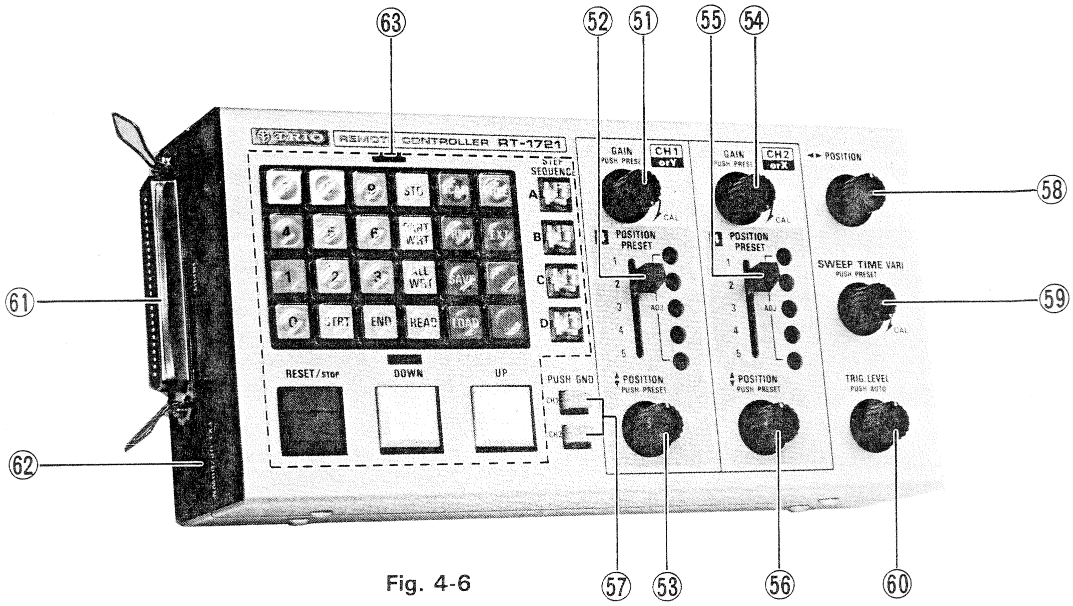


Fig. 4-6

**(51) GAIN PUSH PRESET**
CH1 vertical attenuation fine adjustment control. Continuously variable between the ranges of VOLTS/DIV (1). At CAL position, (fully clockwise), vertical attenuator can be calibrated. For X-Y operation, it becomes the Y-axis attenuation fine adjustment control. When this control is pushed in (PUSH PRESET), the former function is cancelled, and the gain can be set by GAIN PRESET (2) or (29), and the gain is that value which is programmed or selected.

**(52) POSITION PRESET**
CH1 vertical position, preset and preset change-over control. Continuously variable within ± 4 div on the screen. 5 point presets are set and selected.

**(53) POSITION PUSH PRESET**
CH1 vertical position control. POSITION PRESET (52) can be adjusted approximately of ± 2 div. In X-Y operation, Y-axis position control, in addition to POSITION PRESET (52). When this control is pushed in (PUSH PRESET) the former function is cancelled, and the position can be set by POSITION PRESET (52) and the trace is positioned at the programmed or selected position.

**(54) GAIN PUSH PRESET**
CH2 vertical attenuation fine adjustment control. Continuously variable between the range of VOLTS/DIV (5). At CAL position (fully clockwise), vertical attenuation can be calibrated. In X-Y operation it becomes the X-axis attenuation fine adjustment control. When the control is pushed in (PUSH PRESET), the former function is cancelled, and the GAIN PRESET (6) and (33) sets or selects the gain. The gain is then that value selected or programmed.

**(55) POSITION PRESET**
CH2 vertical position preset and preset change-over control. Continuously variable within ± 4 div on the screen. 5 point presets are programmed and selected.

**(56) POSITION PUSH PRESET**
CH2 vertical position control. POSITION PRESET (55) can be adjusted approx ± 2 div. During X-Y operation it serves the dual function of X-axis position control as well as POSITION PRESET (55). When this control is pushed in (PUSH PRESET), the former function is cancelled, and the position can be preset by POSITION PRESET (55), and the trace is positioned at where it was selected or programmed.

**(57) PUSH GND**

| | |
|---|---|
| **CH1:** | When the knob is depressed, input of the vertical amplifier is disconnected from the CH1 input and connected to ground. Therefore the reference level can be easily ascertained. |
| **CH2:** | When the knob is depressed, input of the vertical amplifier is disconnected from the CH2 input and connected to ground. Therefore the reference level can be easily ascertained. |

# CONTROLS AND INDICATORS

**(58) ◄► POSITION**

Horizontal position control. Cannot be used during X-Y operation.

**(59) SWEEP TIME VARI PUSH PRESET**

Sweep time fine adjustment control. Continuously variable between SWEEP TIME/DIV ranges. At fully clockwise CAL setting, sweep time is calibrated. When this control is pushed in (PUSH PRESET) the former function is cancelled, and the sweep rate can be set by SWEEP TIME VARI PRESET (18) and (36) and the sweep rate is that value set or programmed.

**(60) TRIG LEVEL PUSH AUTO**

Adjust starting point for displayed waveform.

**PUSH AUTO:** Sweep will be initiated by trigger signal. Even when there is no trigger signal, free run sweep is possible, and the trace will appear.

**PULL NORM:** Sweep is initiated with trigger signal. Where there is no trigger signal, the sweep will not appear.

> **NOTE**
> When this control is pulled out (PULL NORM) FIX operation is cancelled, and manual operation is selected.

**(61) INPUT**

Connector for oscilloscope CS-1720 and remote controller. Connecting cable provided must be used.

**(62) EXT UP/DOWN (OPTIONAL)**

Mounting point for external UP/DOWN control signal connector.

**<PROGRAMME OPERATION SECTION>**

**(63) PROGRAMME CONSOLE KEYS**

**0 – 9:** Number key. Step numbers and/or block numbers can be set up directly.

**STO:** The memory key. The programme which has been set up can be written into the RAM.

**PART WRT:** The part writing key. Part writing state is actuated by 0-8 block units. READ and WRITE LEDs will light up.

**ALL WRT:** The writing key. All blocks are written into the memory. WRITE LED will light up.

**READ:** The read out key. Programmed data are read from the memory. The READ LED will light up, and the CS-1720 will operate according to the programme contents.

**STRT:** Start step setup key. Used for setting up and reading out start step numbers in STEP SEQUENCE.

**END:** End step point key. Used for setting up and reading out end steps from STEP SEQUENCE.

**SCAN:** Automatic step transfer key; It automatically advances the steps one by one with about a one second interval between steps.

**PRNT:** The printer key. Programme contents are printed out.

**SAVE:** Key for data transfer to memory pack, transferring contents of internal RAM. RAM contents are not altered in any way.

**LOAD:** Data transfer key from memory pack to RAM. Contents of memory pack remain unaltered.

> **NOTE**
> When memory pack is not connected, in order to protect the data, LOAD does not operate.

**FREE:** Programmed function removal key; all programmed function is cancelled, and ordinary oscilloscope operation is resumed with manual operation. All LEDs will be out except POWER warning lamp. The console keys cannot be operated except RESET/STOP (cancelling key).

**EXT:** External signal control key. Step control of signal read out unit can be carried out with external signal. At this time, only STEP will be indicated, and only RESET/STOP key on the console can be operated.

**STEP SEQUENCE:** Programme step (start step to end step) selection key; in steps 00 – 61,4 cases where start or end step has been set can be selected at random.

**RESET/STOP:** Key for resetting and temporary stopping operation;

a) It can be used to read out the preset start step number.

b) When SCAN and PRNT are selected, it becomes a temporary stopping and resetting key.

c) It can cancel FREE and EXT keys.

**DOWN:** Step down key. Brings steps down one by one, stopping at the preset start step, or after reading 00 step.

**UP:** Step up key; goes up through the steps one by one. It returns to the start step after reaching the preset end step, or after reading 61 step.

# OPERATIONS

## INITIAL STARTING PROCEDURE

This procedure is used to standardise the initial setting of controls as a reference point and to obtain a trace on the CRT in preparation for waveform observation. Set the controls as in the diagramme, referring to the section on panel controls and indicators for necessary explanations.

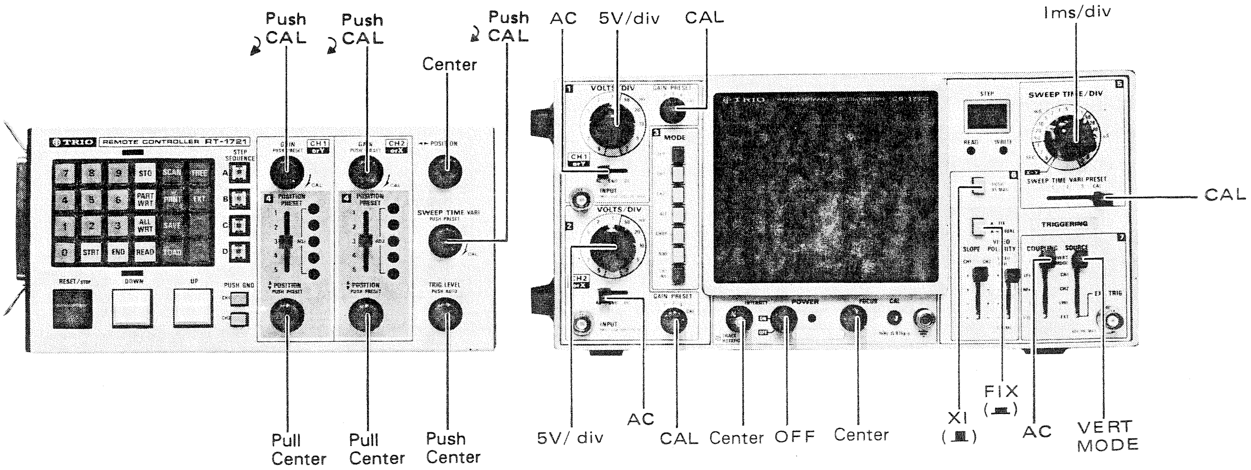


Fig. 5-1

## ORDINARY OSCILLOSCOPE MANUAL OPERATION

1) Turn the POWER switch (12) clockwise, and the power will come on, indicated by the power pilot light. Check if any of the following LED indicators light up: STEP (26), READ (27) and STEP SEQUENCE (63). If all of them are lit, push console key FREE (63) and the LEDs will go out, indicating that the oscilloscope is now ready for ordinary manual operation.

   Set up each mode as follows:

   MODE (9): CH1
   SOURCE (20): VERT MODE
   TRIG LEVEL (60): AUTO

2) After a short time the CRT will warm up, and the trace will appear. Position the trace in the center of the screen using POSITION PRESET (52), ⬍ POSITION (53) (pulled out), and ◄ ► POSITION (58). Next adjust the INTENSITY (10) and FOCUS (14) controls as necessary to obtain a clear, sharp trace.

3) Set the vertical axis MODE (9) to CH1, and apply a signal to CH1 INPUT (4) in order for the waveform to reach normal operational size by rotating VOLTS/DIV (1). Vertical attenuation fine adjustment can be carried out with GAIN (51) switch, pulled into PULL position. By setting vertical MODE to CH2, and applying a signal to CH2 INPUT (8), by following the same procedures as above, CH2 waveform can be observed. By setting vertical mode to ALT, the input signal waveforms of both CH1 and CH2 will be displayed alternately every other sweep, the trigger signal also alternating between CH1 and CH2. Therefore, there will be a momentary pause between the two waveforms.

   When CHOP is selected on vertical MODE, CH1 and CH2 will be indicated by chopping, each sweep. As the trigger signal becomes the CHOP change-over signal in this mode, select an appropriate setting for SOURCE (20), except VERT MODE. These two waveforms have the same time base. When ADD is selected on the vertical MODE, the waveform on the screen becomes a composite algebraic sum of CH1 and CH2 in single trace. If CH2 INV is then selected in this condition, the waveform is the algebraic difference between CH1 and CH2 (CH1 − CH2). When VOLTS/DIV is set the same for both channels, the sensitivity has that value.

### < SEP OPERATION >

Select SEP of the vertical MODE, and set CH1 or CH2. In this setting, the input signals will be indicated by alternate sweeping in main and sub mode with dual trace function. In the case of CH1 being selected, the CH1 signal is the main sweep, the position being adjusted with CH1 ⬍ POSITION. The sub trace can be adjusted to within ±4 div of the CH1 trace by means of SEPARATE PRESET (30) on the left hand side of the CS-1720. It is then controlled by CH1 ⬍ POSITION. The sync polarity of both main and sub traces correspond to CH1 +/− and CH2 +/− of SLOPE (23). (Refer to table 3.) If CH2 is selected, then CH2 becomes the main trace, and CH1 the sub. The same operating instructions apply as for CH1 operation.

**NOTE**

Do not set the sub trace exceed the ±4 div setting, distortion may appear on the waveform.

# OPERATIONS

## < TRIGGERING OPERATION >

In order to observe the input signal waveform, a correct trigger signal is necessary. There are two possible types of trigger; one is the internal trigger, where the signal is internal, and the other is an external trigger, where the trigger signal is applied to the external trigger input terminal; This signal must have a time or frequency relationship to the signal being observed to synchronize the display.

1) A combination of SOURCE and vertical MODE settings decides which signal is the trigger signal, as shown in Table 5-1.

| VERT. MODE \ SOURCE | VERT MODE |  | CH1 | CH2 | LINE | EXT |
|---|---|---|---|---|---|---|
|  | EXCLUDING VERT MODE | VIDEO |  |  |  |  |
| CH1 | CH1 | CH1 | CH1 | CH2 | LINE | EXT |
| CH2 | CH2 | CH2 |  |  |  |  |
| ALT | CH1: CH1<br>CH2: CH2 | CH1<br>see note (1) |  |  |  |  |
| CHOP | see note (2) |  |  |  |  |  |
| ADD | (CH1 + CH2) | (CH1 + CH2) |  |  |  |  |

**Table 5-1 Relation between Vertical MODE and SOURCE**

Note 1) In the case of VIDEO FRAME, the alternate traces of CH1 and CH2 appear on the screen, but both CH1 and CH2 displays are triggered with CH1 signal only.

Note 2) As the CHOP change-over signal becomes the trigger signal, triggering is not properly carried out. In this case, set SOURCE excluding VERT MODE.

2) After setting SOURCE, select MANUAL (■) of FIX/MANUAL (24) and turn TRIG LEVEL (60) to selecte the trigger point. Alternately, by selecting FIX (▬), triggering is automatically fixed in the center of the waveform.

3) By pulling the TRIG LEVEL control to outward, NORMAL operation is selected, under which triggering is not automatic, so that in the case of no trigger signal or the trigger level is too low, no trace will appear. Table 5-2 shows the relation between FIX/MANUAL and AUTO/NORMAL.

| FIX/MANUAL \ TRIG LEVEL | AUTO (PUSH) | NORMAL (PULL) |
|---|---|---|
| FIX | Auto sweep<br>Level fix | Triggered sweep<br>Level adjustable |
| MANUAL | Auto sweep<br>Level adjustable | Triggered sweep<br>Level adjustable |

**Table 5-2 The Relation between FIX/MANUAL and AUTO/NORMAL**

## < SYNC POLARITY >

SLOPE (23) sets the sync polarity of CH1 +/−, CH2 +/−. In the case of VIDEO FRAME, odd and even fields can be selected.

| SEPA-RATE | VERTI-CAL MODE \ SOURCE | VERT MODE | CH1 | CH2 | LINE, EXT |
|---|---|---|---|---|---|
| ON | CH1 | Main: CH1 +/−<br>Sub: CH2 +/− | CH1 +/− | CH2 +/− | Main: CH1 +/−<br>Sub: CH2 +/− |
|  | CH2 | Main: CH2 +/−<br>Sub: CH1 +/− |  |  | Main: CH2 +/−<br>Sub: CH1 +/− |
| OFF | CH1 | CH1 +/− | CH1 +/− | CH2 +/− | CH1 +/− |
|  | CH2 | CH2 +/− |  |  | CH2 +/− |
|  | ALT | CH1: CH1 +/−<br>CH2: CH2 +/− |  |  | CH1: CH1 +/−<br>CH2: CH2 +/− |
|  | CHOP |  |  |  | CH1 +/− |
|  | ADD | CH1 +/− |  |  |  |

**Table 5-3 Sync Polarity**

## < VIDEO SYNC >

When COUPLING (21) switch is in the VIDEO, the sync is on the VIDEO signal.

1) When VIDEO POLARITY (22) switch is in the VIDEO LINE, the trigger signal is the horizontal sync signal (TV. H) on the VIDEO signal.
   When VIDEO POLARITY switch is in the FRAME, triggering is carried out by vertical sync signal (TV. V) on the VIDEO signal.
2) According to the waveform of the VIDEO input signal select VIDEO POLARITY LINE (+/−) or FRAME (+/−) depending on the polarity of the sync signal. When VIDEO FRAME is selected, odd and even fields can be set by SLOPE (23) CH1 +/− or CH2 +/−. The polarity of the observed waveform may be reversed when moving from one monitoring point to another; Therefore, it may be necessary to switch from VIDEO POLARITY + to − (or − to +) or vice versa.
3) Field selection in single trace observation.
   Set SOURCE in CH1 or VERT MODE, and synchronize the input VIDEO signal for CH1. Now odd and even fields can be selected using SLOPE CH1 +/−. For CH2, SLOPE CH2 +/− changes the field.
4) Field selection in dual trace operation.

- When SOURCE is set to VERT MODE, vertical MODE to ALT, and the same signal is applied to CH1 and CH2, the input signal of CH1 will be the trigger signal. Now odd or even field can be selected using SLOPE CH1 +/− or CH2 +/− respectively. When CH1 +/CH2 − or CH1 −/CH2 + is set, it is possible to view odd and even fields simultaneously.
- When SOURCE is set to VERT MODE and CH1 SEP mode is selected, SLOPE is CH1 +/− on the main and CH2 +/− on sub. Odd or even field can be selected respectivily. In the case of CH2 SEP mode, SLOPE is CH2 +/− on main and CH1 +/− on sub. When CH1 +/CH2 − or CH1 −/CH2 + is set, it is possible to view odd and even fields simultaneously.

# OPERATIONS

### <SWEEP MAGNIFICATION>

If a part of the trace were enlarged on the screen, that part which is selected for close observation might be off the screen, when the sweep rate is shorted. In such a case, the following procedure should be carried out. First, using the ◄ ► POSITION adjust the desired portion of waveform to center of the CRT. Secondly, depress X5 MAG (19) knob (▃) and the trace will be enlarged five times. The sweep rate in this case becomes one-fifth of the set value of SWEEP TIME/DIV.

### <X-Y OPERATION>

By using the oscilloscope CS-1720 for X-Y operation, frequency response, frequency measurements, phase shift measurement and other similar measuring functions can be carried out. Turn the SWEEP TIME/DIV control fully counterclockwise to the X-Y position. The CH1 (or Y) signal indicates the vertical axis Y, and the CH2 (or X) signal indicates the horizontal axis X. Adjustment of the X-Y position is carried out using CH1 ⬍ POSITION for the Y-axis and the CH2 ⬍ POSITION for the X-axis. The sensitivity of both X and Y components during X-Y operation is controlled by VOLTS/DIV, VARIABLE in CH1 and CH2 respectively.

## PROGRAMMING

Programming for the CS-1720 oscilloscope is carried out completely by console key operation. The keys are classified under three types according to the function.

### 1) Number keys

0 – 9

### 2) One-key operation

RESET, UP, DOWN, SCAN, PRNT, FREE,
EXT, SAVE, LOAD, A, B, C, D:

### 3) Multi-key operation

ALL WRT, PART WRT, STO, READ, STRT, END.
The operating contents of these keys will be changed at any time by pre-keying or further keying.

### 1. EXPLANATION OF CONSOLE FUNCTIONS

### 1) 0 – 9

These keys set up the step numbers and/or the block number for part writing. The keyed step number will be indicated on the seven-segment STEP LEDs. Two numbers will be indicated for steps 00 – 61, but only one figure will be indicated for block numbers 1 – 8.

### 2) RESET/STOP

Basically this key returns the programme to the START STEP of the sequence regardless of the set condition. The CS-1720 will then remain in the READ condition. In the case of SCAN or PRINT operation, this key serves as a pause or reset key. If the key is pressed once, in SCAN or PRINT operation, the CS-1720 will pause in the middle of the operation. If the SCAN or PRNT key is then pressed, operation will resume. If the RESET key is pressed twice in succession, the programme will return to the START position, PRINT or SCAN will stop, and the CS-1720 will remain in a READ condition.

### 3) UP

This control advances the step numbers one by one from the STEP number indicated. When END STEP is reached, it returns to START STEP of the step sequence. If no END STEP is set, or if the UP key is pushed beyond the END STEP key setting, steps will proceed to the last step 61, and will then return to the START STEP of the step sequence, and stop.

### 4) DOWN

Reduces STEP numbers one by one from indicated STEP number until START STEP of step sequence is reached, and it will stop. If there is no set START STEP, or if the DOWN key is pressed before the START STEP setting it will return to step 00, and then go on to the START STEP, and stop.

### 5) STEP SEQUENCE (A, B, C, D)

The combination between programme start and step can be set in up to 4 settings (A, B, C, D). Following the programmed STEP number, steps can then be set up at random continuously between 00 – 61. This combination is set from the A to D keys, and once selected, the oscilloscope will be in the READ condition at the start step. The A, B, C, D programme is preset, and remains set when the power is OFF, being indicated by the appropriate LEDs when power is once again switched on.

### 6) SCAN

In READ condition, SCAN operation advances the steps one by one with a one-second interval between steps until the END STEP is reached, when it will return to the START STEP and stop in READ. However if no END STEP is set or if the SCAN key is pushed beyond the END STEP setting, the steps will be advanced until 61, after which it will return to the START STEP and stop.

**Pause action:** Pause in SCAN action is achieved by pressing the RESET key. If the SCAN key is again pressed, scanning will resume.

**Cancellation:** If the RESET key is pressed twice in succession, the SCAN action will be cancelled, and the CS-1720 will return to the START STEP, in read condition.

# OPERATIONS

### 7) PRNT

Operates the printer, TP-1724, and the programme data are printed out. Printing is done from the step indicated and continues until step 61, when printing will stop and the CS-1720 will return to the START STEP in the step sequence.

**Pause action:** Pause of printing action is achieved by pressing the RESET key once. The printer will print up to the 8 block of that step, and stop. Pressing again the PRNT key will resume printing from the following step.

**Cancellation:** Cancelling printing is done by pressing RESET key twice in succession, when the CS-1720 will return to the START STEP of the step sequence, and printing will stop.

### 8) FREE

All programmed functions are cancelled, and the CS-1720 becomes a normal oscilloscope with manual control. At this time, FREE can be cancelled by pressing RESET.

### 9) EXT

The STEP number can be controlled by the external BCD signal, connected to EXT I/O. EXT action is only possible under READ condition, when the STEP SEQUENCE LED is off. When the external signal is disconnected, step sequence 00 is indicated. To cancel EXT action press RESET.

**NOTE**

During SCAN, PRNT, FREE, and EXT action, all keys except RESET are cancelled and inoperable.

### 10) SAVE

Transfers the RAM programme data in the memory of the CS-1720 to the memory pack MT-1725. This transfer is effected without changing the RAM contents of the CS-1720 internal memory. When data transfer is finished, a buzzer will sound and the READ or WRITE LED will flash once.

### 11) LOAD

Transfers the contents of the memory pack MT-1725 to the internal RAM of the CS-1720, without altering the memory pack contents. When the transfer is finished, the buzzer sounds and the READ or WRITE LED will flash as in SAVE above.

When the memory pack is not connected, LOAD will not operate to protect the data in the memory.

**NOTE**

If SAVE is pushed by mistake instead of LOAD, or vice versa, all important data will be changed. Accordingly be sure to press the correct key.

### 12) STRT

Start step sequence key. Used for setting up START STEP numbers and/or read out the start step number of the sequence.

### 13) END

End step sequence key. Used for setting up END STEP numbers and/or read out the end step number of the sequence.

### 14) READ

The read out key. When pressed, the green READ LED will light and programme will be read out at the indicated step. It operates according to the programme contents.

### 15) ALL WRT

All blocks are set in WRITE state completely and total panel control operation is possible; and red WRITE LED will light. All panel controls can be set up for programming.

**NOTE**

The data of the panel set up is stored into RAM only when STO key is pressed.

### 16) PART WRT

Selects part writing function both READ and WRITE LEDs light up and STEP LED is off.

Set up one of the block number keys from 1 to 8, which necessary to change the mode. In this case, only block number which has been set in PART WRITE state, is indicated in one figure. Panel control operation is possible in the only block which has been set up and can be set up for programming. All other blocks are set in READ state, therefore panel control operation is impossible.

**NOTE**

When STO key is pressed, part writing of only the block preset will be done, without altering the rest of the blocks.

If it is necessary to change the block number to be part written, press the desired key before pressing the STO key. After part writing is completed, the step number is advanced by one, and is so indicated. The oscilloscope will be in ALL WRT state.

### 17) STO

The memory activation key. It is used for all writing actions, ALL WRT, PART WRT, START STEP, END STEP.

**ALL WRT:** The programme setting of each panel switch in all blocks is stored as data, advancing the step number by one.

**PART-WRT:** Each panel switch programme setting in designated block only, is stored as data, advancing step number by one.

**STRT/END:** Sets up start steps and end steps of the programme and writes them.

# OPERATIONS

## 2. PROGRAMME OPERATION

Referring to the section on manual oscilloscope operation, switch on the power switch. Check if any of the STEP (26), READ (27) LEDs and one of the STEP SEQUENCE LEDs are lit or not. With the green READ LED lit, the oscilloscope is ready for operation.

**NOTE**

If at the beginning of operation the first stage programme setting has not been done, all A, B, C, D LEDs may be lit and the buzzer may be sounding. In this case, reset A, B, C, D or push the RESET key. If the buzzer continues to sound, turn power OFF and check each external cable connection before switching on again.

When the oscilloscope is ready for operation, press the RESET key.

### I) UP/DOWN Operation for STEP

**Continuous STEP UP**

With each operation of the UP key, STEP is advanced one by one. When END STEP is reached, it returns to the START STEP. If the UP key is pushed after the END STEP setting, the steps will be advanced until step 61, after which it will return to START STEP. If the UP key is pressed from a number below START STEP, the steps will be advanced till END STEP, and will then return to START STEP.

**Continuous STEP DOWN**

Each operation of the DOWN key will reverse the step numbers indicated by one, until the START STEP is reached, and operation will stop. If the DOWN key is pressed at a number below the preset START STEP, the steps will go down to OO, then to START STEP and operation will stop. If DOWN is keyed beyond END STEP preset number, normal decrease of steps occurs till START STEP, then operation will stop.

### II) START STEP, END STEP Setting

**a) STEP SEQUENCE setting**

Select one of the keys from A to D and push. The corresponding LED will light up.

**b) START STEP setting**

Using the number keys, indicate in the window the number of the required step. Push START and STO key in that order, then the START STEP is set up.

**c) END STEP setting**

Using the number keys, indicate in the window the required number. Push END and STO keys in that order, and the END STEP is set up. Now the programme extent has been set up and recorded in the memory. Using the same procedure as above, three other sequence can be set up.

### III) START — END STEP Reading out

**a) STEP SEQUENCE selection**

From A to D keys select the key to be read, and push it. At this time the START STEP number is indicated in the STEP (26) window, and the oscilloscope will be in the READ state.

**b) START STEP, END STEP reading**

By pushing START and READ keys in that order, start step reading is possible; similarly, if END and READ keys are pushed in that order, end step reading can be carried out.

### IV) PROGRAMME Writing Operation

**(1) ALL WRITE**

**a) STEP Number setting**

Set up STEP number for STEP (26) using number keys or UP/DOWN key.

**b) ALL WRITE setting**

When ALL-WRT key is pushed, the green READ LED will go out, and the red WRITE LED will light. In this setting, panel operation of the oscilloscope is possible.

**c) Writing in**

By pushing STO key, the setting of every control is stored into the memory. The STEP number is advanced by one to the next step, and the oscilloscope is still in the WRITE condition.

**d) Continuous writing in**

Under setting (c) above, if each switch is set up and the STO key operated in that order, the programme can be continuously written in.

**(2) PART WRITING in**

**a) STEP number setting**

Set up as for ALL WRT above.

**b) PART WRITING in setting**

By pushing PART WRT key, the STEP LED (26) will go out, and the green and red LEDs of READ and WRITE will light up; the oscilloscope is now in PART WRT condition. Set up the desired block number from 1 to 8, using the number keys. The number will be indicated in the STEP window of the front panel. Panel operation is only possible for the preset block, and the setting for each control will be written in. All other blocks are in READ condition, and panel operation with them is not possible.

**c) Writing in**

By pushing STO key only the memory of the contents of the set up block can be changed. The STEP number is advanced by one to the next step, and the CS-1720 is in ALL WRITE condition.

# OPERATIONS

### V) Programme Reading Operation

**(1) Setting up for READ condition**

**a) Reading of START STEP**

By keying RESET or STEP SEQUENCE, START STEP reading condition is achieved. In this case reading from programme in the STEP SEQUENCE can be continuously carried out, using the UP key.

**b) Reading of direct STEP**

Set up the desired step numbers using the numbers key or UP/DOWN key. The numbers will be indicated in the STEP window (26) on the CS-1720 front panel. By pressing READ key any step can then be directly read.

### VI) Manual Operation of CS-1720 Oscilloscope

When FREE key is pressed, all programmed functions are cancelled and manual operation of the CS-1720 is possible as for any normal oscilloscope. The LEDs for STEP, READ, WRITE, and STEP SEQUENCE are all off. All keys except RESET cannot be used. By pushing the RESET key, FREE action is cancelled.

### VII) Automatic Step Transfer Operation

In READ condition, pushing the SCAN key automatically advances the STEP setting from the indicated step through to the end, with a period of about one second between steps. When the end step is reached, the CS-1720 automatically returns to the START STEP and stops.

During SCAN operation, all keys except RESET are inoperable.

**Pause action:** During SCAN operation, pushing the RESET key will temporarily stop the action. To continue, press the RESET key once again.

**Cancellation:** The SCAN operation can be stopped if the RESET key is pressed twice in succession. In such a case, the CS-1720 will return to the START STEP and stops.

## OPERATION OF OPTION

### I) Probe Selector Control and Operating Instructions

The Probe Selector (RU-1722, RU-1723) control can be used in combination with CH1 input, CH2 input, and EXT input of the CS-1720. Also, manual operation of the oscilloscope with the probe selector is possible after pushing FREE key. In Programmed action, the selector becomes the programme section for one part of blocks 7 and 8.

**a) Connections with RU-1722**

In combination with RU-1722, inputs can be selected as follows:

| | |
|---|---|
| CH1; | 5 inputs |
| CH2; | 5 inputs |
| EXT; | 3 inputs |

**b) Connections with RU-1723**

The following inputs can be selected in combination;

| | |
|---|---|
| CH1; | 10 inputs |
| CH2; | 10 inputs |
| EXT; | 3 inputs |

**NOTE**

(1) The probe selector (RU-1722, RU-1723) power is interconnected with the CS-1720 oscilloscope. For detailed connection and operation instructions, refer to the probe selector instruction manual.
(2) When connecting and disconnecting the probe selectors, make sure power switch of the CS-1720 is in the OFF position.
(3) Use CH1 and CH2 input coupling of oscilloscope in the AC position.

### II) Operation of The Printer

Connect the Thermal printer TP-1724 to the PRINTER I/O connector on the rear panel of the CS-1720, referring to the printer TP-1724 instruction manual for detailed instructions. Pressing PRNT key activates the printer, and a hard copy of the programme data is printed out, from the step indicated at the time of pressing the PRNT key to step 61, whereafter it will return to START STEP and stop. During printing, the step number indicated on the CS-1720 STEP window will not alter, and all keys except RESET are inoperable.

**Pause action:** During PRINT action, press RESET key. Print-out will continue till the end of that step, and stop. When PRNT key is pushed again, print-out will continue from the next step.

**Cancellation:** Print operation can be fully stopped if the RESET key is pressed twice in succession. Print-out will stop, and the CS-1720 will return to START STEP.

**NOTE**

If PRNT key is pressed when the printer is not or improperly corrected, a warning buzzer will sound. The buzzer can be cancelled by pressing RESET key.

### III) Programme Transfer

By connecting Memory Pack MT-1725 to the EXT I/O connector on the rear panel of the CS-1720, data of internal RAM can be transferred in or out.

**a) From CS-1720 to Memory Pack MT-1725**

By operating SAVE key, programme data contents of the RAM are transferred to the Memory Pack MT-1725.

**b) From Memory Pack MT-1720 to CS-1720**

By pressing LOAD key, contents of memory pack will be transferred to CS-1720 internal RAM.

# OPERATIONS

both transfer modes, the programme contents of the nsferring unit remain unaltered. When transfer is mplete, a buzzer will sound, and the READ or WRITE LED flash once.

> **NOTE**
>
> When the memory pack is not connected, LOAD key is not effect to protect the data. When connecting or disconnecting the memory pack, be sure power is OFF in order to protect the data. In addition, do not subject the equipment to electrical shocks, due to the fact that the body contains the back-up battery for the memory. High temperature and humidity should also be avoided. When the Memory pack back-up battery is low, the STEP LEDs will flash on and off indicating a change of battery is necessary. If a mistake is made, and SAVE is pressed instead of LOAD, or vice versa, the data will be lost, therefore great care should be taken to push the correct button.

### VI) Step Control Operation from External BCD Signal

Step numbers can be controlled from an external BCD unit connected to the EXT I/O socket on the rear of the CS-1720 body. EXT operation is only possible in READ operating condition, with STEP SEQUENCE LED off. If no external signal is connected, when this key is pushed, step 00 will be indicated. To cancel EXT operation, push RESET key.

# CIRCUIT DESCRIPTION

## GENERAL

**Refer to the block diagramme**

The programmable part of oscilloscope CS-1720 is an all-logic control circuit. Logic control means that the oscilloscope is controlled by the logic signal only, without selector switches. Thus in the programmable computer CS-1720, there are many relay switches, analogue switches and transistor switches. This logic signal controls several circuits from CPU unit memory through the output port of I/O unit. The logic signals coming from the various switches on the front panel of the CS-1720, remote control unit , probe selector, etc. are connected to the input port of the I/O unit, and can be stored into the CPU unit memory using the STO key on the keyboard. The memory, switches, and circuits are related to each other as indicated in Fig. 6-1 (Input/Output Port is abbreviated).

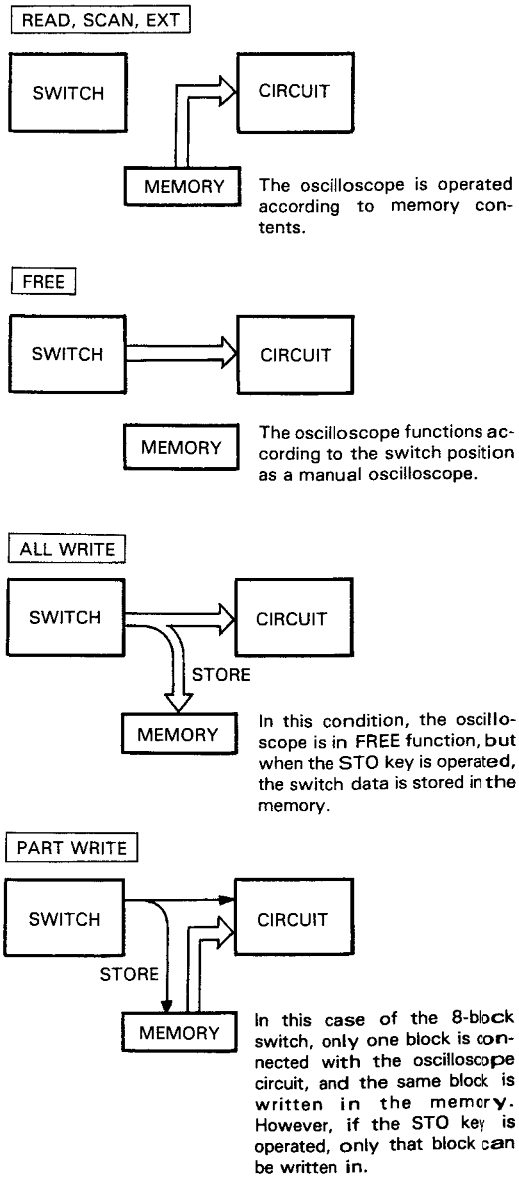
## SWITCH, ENCODE, DECODE CIRCUIT

The I/O unit is in the center of the connection diagrammes 7-1 and 7-2. In Fig. 6-1, the SWITCH is shown on the left side and the CIRCUIT is shown on the right side of the connection diagram 7-1, 7-2. FI17 and FO17 circuits as seen in the diagramme have the following meanings:

F.............Function
I...............Input port (switch side) signal
O ............Output port signal (circuit side)
1..............1 is a sample number from number 1-8. These numbers correspond to the block numbers located on the control panels of the CS-1720 oscilloscope, the remote control unit and the probe selector unit. 1 is the channel 1 VOLTS/DIV, AC/DC switch position.
7..............Each block is composed of 0-7 8 bits. The bit number is this number. No. 7 corresponds to the AC/DC switch of CH1.

For example, if the signal level of FI17 is high, the CH1 AC/DC switch is set to AC. When the level is low, DC is selected. When the signal level of FO17 is high, then CH1 AC/DC switch is set to AC coupling; when the level is low, DC coupling is selected. To know the switch position and the port bit pattern refer to troubleshooting section, Table 9-1 and 9-2. Since there are many contact points in the SWEEP TIME/DIV switch, use the encoder and convert to 6 bit (FI50-FI55).

R8-R36 and C8-C36 of the vertical logic unit act as a noise rejection filter.



The oscilloscope is operated according to memory contents.

The oscilloscope functions according to the switch position as a manual oscilloscope.

In this condition, the oscilloscope is in FREE function, but when the STO key is operated, the switch data is stored in the memory.

In this case of the 8-block switch, only one block is connected with the oscilloscope circuit, and the same block is written in the memory. However, if the STO key is operated, only that block can be written in.

Fig. 6-1

## ATTENUATION CIRCUIT

**Refer to connection diagramme 7-3**

Attenuation circuit selection is achieved using relays. By using the attenuation circuit, attenuation of 1/1, 1/10, 1/100 and 1/1000 can be achieved. The 1/1000 attenuation is achieved by using the 1/10 and 1/100 attenuation in series connection. An attenuation sequence of 1-2-5 selector is composed of the vertical amp unit RL1 -RL4. These relays switch the amplifier load resistance and change the gain. The relationship between VOLTS/DIV and each control signal is shown in toubleshooting section, Table 9-4. When the AC-GND-DC switch is in the GND position, RL1 and RL5 are activated. RL2 is the relay for AC/DC selection. Q1-Q4 is a buffer amplifier which is an impedance converter.

# CIRCUIT DESCRIPTION

## VERTICAL AMPLIFIER

The converted impedance signal in the attenuator unit is amplified in the vertical amplifier unit. This amplifier is composed of 5 steps involving CH1 and CH2 selector circuit and trace separation circuit, obtaining a gain of approximately 50 dB. These amp units are all composed of differential amplifiers with cascode series stages, except for the trace separation circuit. The first and second stage amps use a constant current source in order to obtain a high CMRR (COMMON MODE REJECTION RATIO). (CH1, Q3, Q6 and Channel 2, Q37, Q40). The second stage amplifier operate GAIN VERIABLE PRESET. Refer to connection diagram 7-4.

FET's Q9 and Q10 in the vertical amplifier unit control CH1 GAIN VARIABLE resistor. When GAIN PRESET is set to CAL, the gate voltage of the FET circuits becomes lower than the pinch off voltage; the value of the resistance $R_{DS}$ between drain and source becomes very high. When gate voltage is high, $R_{DS}$ value is small, and when gate and drain voltages are same level, $R_{DS}$ value is several tens ohm. In this case the second amp gain is at minimum. VR1-VR4 and VR6-VR9 of the attenuator unit act as preset for this gate voltage. IC1 and IC2 in the vertical logic unit act as the analogue switch, and select one of the preset voltage levels. CH1 and CH2 GAIN volume controls of the remote control unit are pull/push switches. When these switches are pulled, INH (INHIBIT) of IC1 and IC2 is at a high level, and the FET gate is separated from the preset volume, and connected to the GAIN volume control of the remote control unit.

The third amplifier effects preset of the vertical position. Vertical position is also controlled by DC, the same as GAIN PRESET. This DC voltage is supplied to the base of Q15 and Q16 of CH1 and Q51 and Q52 of channel 2. Fig. 7-5 is the circuit diagramme of the POSITION PRESET function. The position control signal (CH1/CH2, POS1, POS2) is obtained by IC and transistor switch of the remote control unit. In the third amp on channel 2 side, INVERT operation is carried out in addition to vertical position . In the usual case Q47 and Q48 are operated as differential amplifiers, and Q49 is in cut off state. In the case of INV operation Q49 and Q50 are on; Q47 and Q48 are cut off, and as a result of this, phase is inverted. Q53-Q56 operate as the selector switches for the above operation.

The CH1 OUT amplifier consists of Q21, Q22 and Q31-Q34. Q31-Q34 act as the darlington connected complementary symmetry emitter follower with an output impedance of approximately 50 Ω.

Q63 and Q64 act as the amplifier in CH2 X-axis, during X-Y operation. Q23 and Q24 act as the trigger amplifier for channel 1, and for CH2, Q61 and Q62.

Q25-Q30, Q65-Q70, Q75, and Q76 also act as amplifiers by means of selector circuits CH1 and CH2. When Q of P13 is at a high level, and $\overline{Q}$ is at a low level, Q68 and Q69 are OFF. In this case, CH1 is selected. If on the other hand Q is low and $\overline{Q}$ is high and Q28, Q29 are OFF, CH2 is selected. In the ADD state, Q and $\overline{Q}$ levels are both high. When ADD is selected, Q71 and Q72 are the transistor switches, whose function is to keep the operational level of the circuit constant.

Q73 and Q74 are the amplifiers to pick up the trigger source when VERTICAL MODE is selected. The output of CH1 and CH2 selector circuit goes into the trace separation circuit Q77-Q89 through the delay line. When SEP switch is OFF position, in P12 the TS is low, $\overline{\mathrm{TS}}$ is high, Q81 and Q82 are OFF, and Q79 is ON. When SEP switch is ON position, during sub sweep operation, TS is high, $\overline{\mathrm{TH}}$ is low, Q79 is OFF, and Q80 is ON. According to the voltage of SEP position of P14 the current from Q80 is supplied to Q77 and Q78 and position is moved. Q84 and Q85 make up the amplitude limiter system so as not to saturate the vertical output amplifier. Q86-Q89 are buffer amplifiers and have a low output impedance.

Q90-Q95 are the transistor switches in order to select the trigger signal for CH1, CH2, V. MODE. According to the $\overline{\mathrm{CH1}}$, $\overline{\mathrm{CH2}}$ and $\overline{\mathrm{V.\ MODE}}$ signal, of P10, the output is realised as the trigger source at P11.

## SWEEP UNIT

The internal sync signal from the vertical amplifier unit goes in to the trigger source selector circuit through Q1 and Q2 amplifier circuit. The relays RL1 and RL2 select the sync signals INT, EXT and LINE. RL3, RL4 and Q7 make up the trigger source coupling change-over circuit. When $\overline{\mathrm{DC}}$, $\overline{\mathrm{LF}_{REJ}}$ and $\overline{\mathrm{HF}_{REJ}}$ are in high level, AC coupling comes into effect. Q5 and Q6 comprise the FIX SYNC circuit, and detect positive/negative peak-levels of the trigger source; the center value between positive and negative levels acts as the trigger level. Q8 ~ Q20 are trig amplifier. A Schmidt circuit restores the trigger amplifier output, and after various operations, the trigger amplifier output becomes the clock for flip-flop IC7a as a trigger pulse.

Fig. 6-2 is a detailed block diagram of the above circuit. When the trigger coupling is not set to VIDEO, the trigger amplifier output signal is fed to the Schmidt circuit. This output becomes the clock after selected by SLOPE of P39. When the trigger coupling is set to VIDEO, from the trigger amplifier output signal, the emitter of Q19, only the SYNC signal is picked up by the SYNC separation circuit (Q20). When VIDEO FRAME operation is selected, Q21 is the integral circuit switch to remove the LINE SYNC signal. The SYNC signal through the integral circuit appears in each field. This signal is divided by IC7b and is synchronized

# CIRCUIT DESCRIPTION

with FRAME. The gate circuit of IC3 selects LINE and FRAME. The VIDEO SYNC signal polarity is selected by IC4c and IC4d.

The AUTO circuit is composed of IC4a and IC4b, and Q23, Q24 of the sweep unit. If there is no trigger signal when the AUTO/NOR switch is set to AUTO, the input signal of NAND GATE, IC6d, goes into high level, and sweep is started when the HOLDOFF circuit is in the positive timing. When there is a trigger signal, or when the NOR position of the AUTO/NOR switch is selected, the AUTO circuit output falls to the low level and sweep is synchronised with the negative timing of IC7a clock.

Fig. 6-3 shows the basic circuit of the sweep generator. When Q25 is OFF, according to the SWEEP GATE signal, the timing condensers C30 and C31 are charged by the constant current circuit (Q35), decided by the timing resistors, (R91-R101), and sawtooth wave is obtained. When this sawtooth wave reaches a prescribed level, the Schmidt output of the HOLDOFF circuit is inverted, the sweep gate signal rises to high level, and Q25 is switched on. As a result of these processes, the timing condenser is discharged. The timing resistor $R_T$ is selected by the selector switch composed of Q36 to Q51. In addition the timing condenser can be altered by the switch composed of Q28-Q33. The selector signal is controlled by $\overline{\text{RT1}}$-$\overline{\text{RT8}}$ and $\overline{\text{CT1}}$-$\overline{\text{CT7}}$ of P41. Refer to Table 9-3 indicated troubleshooting.

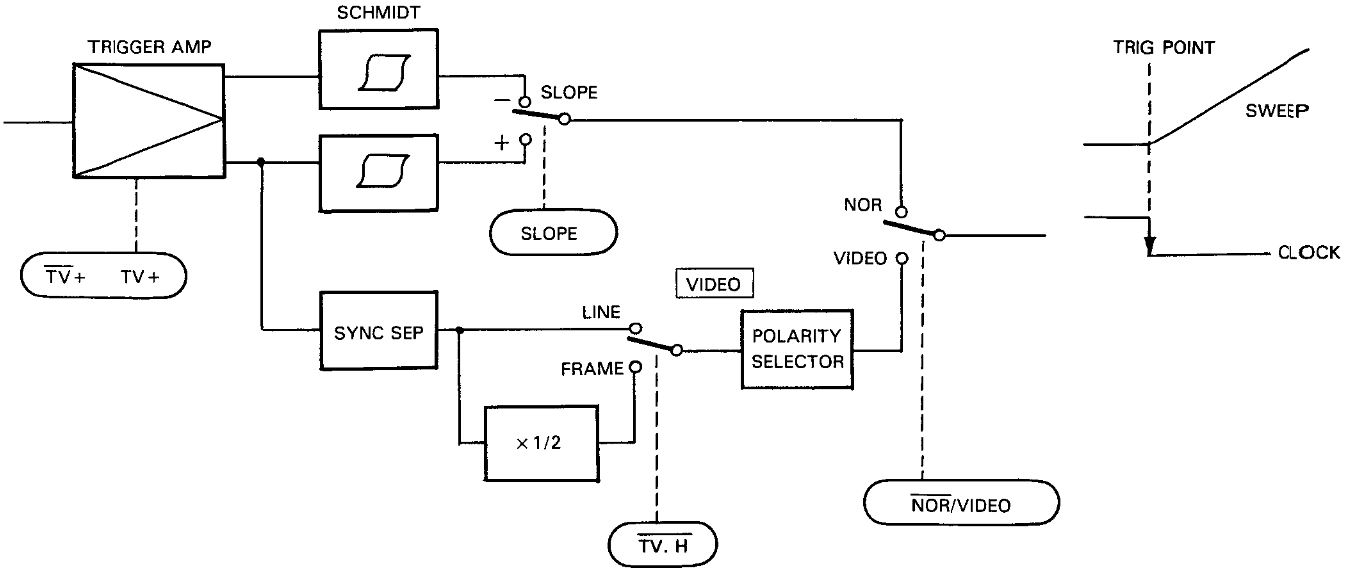


Fig. 6-2 Detail Block Diagram of Trigger Logic

# CIRCUIT DESCRIPTION

DC voltage is added to the base of Q35 in order to carry out SWEEP VARI PRESET. This voltage controls the constant current source output. The SWEEP TIME VARI PRESET circuit can be seen in connection diragram 7-6. The preset voltage is set by VR1-VR4 of the horizontal switch unit, and is selected by the switch (Q1-Q4). If the SWEEP TIME VARI volume switch is pulled (on the remote controller), switch Q1-Q4 is OFF and depending on the position of VR15, the preset voltage is changed.

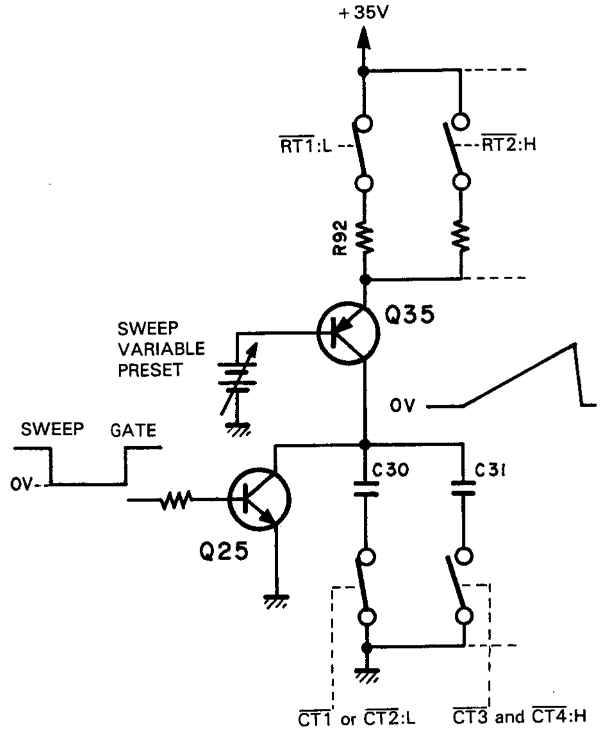


**Fig. 6-3 Basic Circuit of Sweep Generator**

IC8b, IC8c, IC10, Q27 and Q28 of the sweep unit comprise the HOLDOFF circuit. The sawtooth waveform signal, impedance is converted by Q54, is added to the Schmidt circuit composed of Q27, Q28, IC8b and IC8c. When the sawtooth waveform signal is above the prescribed level, the Schmidt circuit output is inverted, the sweep gate level is high and the timing condenser is discharged. At this time, D25 is OFF, so the input to the Schmidt circuit falls by a time constant, determined by hold-off condensers C24-C29 and R77. When the voltage drops below the hysterisis level of the Schmidt circuit, the Schmidt output level is high, and goes into trigger wait condition. IC10 is the HOLDOFF condenser selector switch. In the 0.5µs and 0.2µs ranges, all switches are OFF, and the HOLDOFF condenser becomes a stray capacitor for the switch. The waveform of each part is illustrated in Fig. 6-4

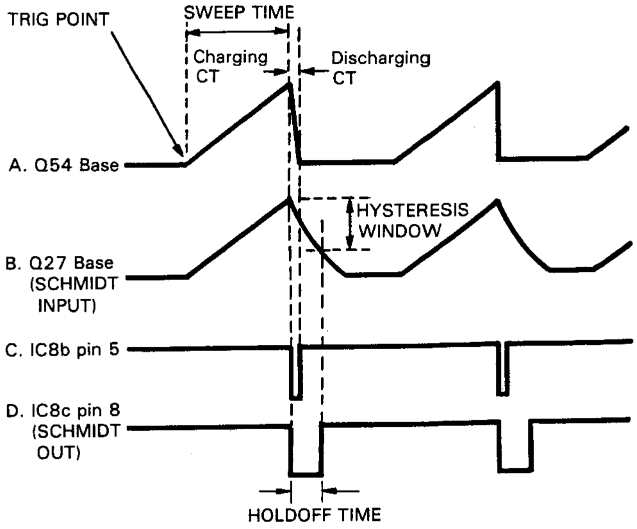


**Fig. 6-4 Waveform of HOLDOFF Circuit**

IC9a and IC9d form the CHOP selector oscillator circuit, with a frequency of approximately 400 kHz. IC9b and IC9c act as chop oscillator and as blanking signal from SWEEP GATE signal and have signal $Q_o$ which select vertical axis CH1 and CH2. Q56 and Q57 form the selector switch in order to send the X-axis signal to the horizontal amplifier, in X-Y operation. Q60 and Q61 control the base bias of the transistor switches. The calibaration voltage generator circuit is composed of Q63-Q65.

## VERTICAL OUTPUT AMPLIFIER UNIT

The signal from the vertical amplifier is amplified by the vertical output amplifier unit with a gain of 20 dB. Q5 is the active load of the cascode amplifier Q1 and Q3; peaking is carried out by C11.

## VERTICAL AND HORIZONTAL LOGIC UNIT

Refer to the connection diagramme, 7-2. In the vertical and horizontal logic unit, encode/decode, vertical mode, trigger source, and coupling slope signals are converted to achieve perfect control of the vertical amplifier and sweep unit. IC9b acts as a flip-flop for CH1 and CH2 selection in the vertical amplifier. RS flip-flop operation is carried out by $\overline{\text{CH1 SET}}$ and $\overline{\text{CH2 SET}}$ in single trace operation. In dual trace operation, CH1 and CH2 selection are carried out by the negative edge of the clock input. In ALT mode the timing is effected by the end of the sweep, and in CHOP, the CHOP signal carries out the timing.

IC9a selects trace separation using the negative edge of the sweep gate signal. IC5-IC7, and IC8b, IC8c and IC8d produce the signal for selection of the trigger source; these signals are $\overline{\text{V.MODE}}$, $\overline{\text{CH1}}$ and $\overline{\text{CH2}}$, from the vertical mode signal, trigger source and the vertical selector signal (Q). IC4 and IC8b are the switches for slope selection. Refer to Fig, 6-5 for the time chart.

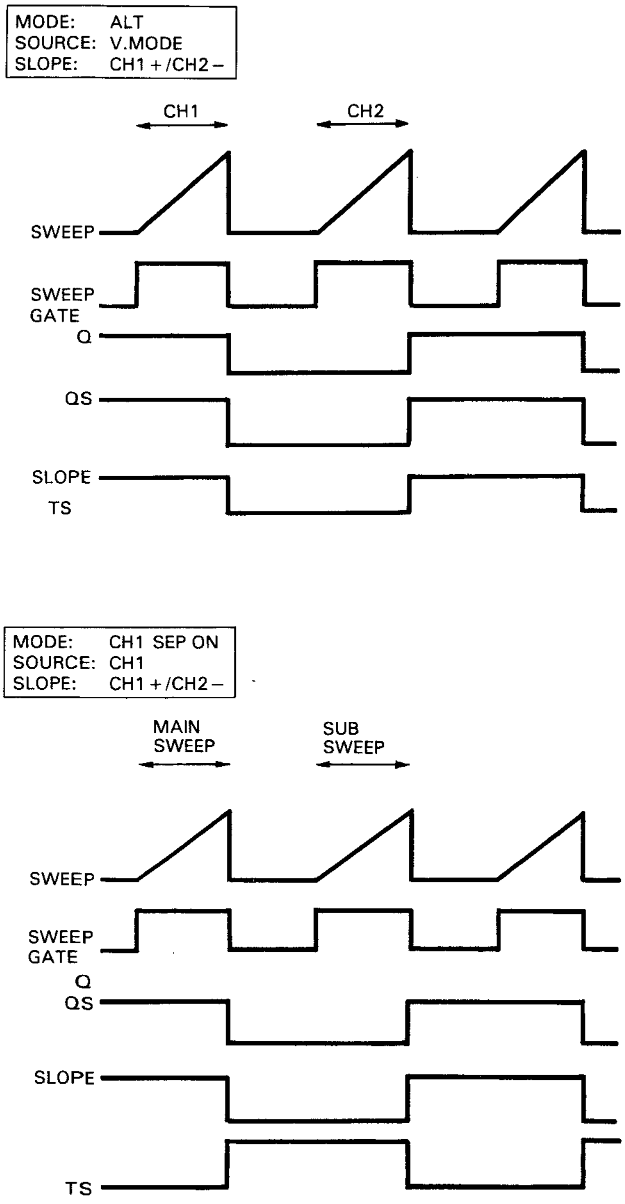

MODE: ALT
SOURCE: V.MODE
SLOPE: CH1 +/CH2 −
CH1
CH2
SWEEP
SWEEP GATE
Q
QS
SLOPE
TS
MODE: CH1 SEP ON
SOURCE: CH1
SLOPE: CH1 +/CH2 −
MAIN SWEEP
SUB SWEEP
SWEEP
SWEEP GATE
Q
QS
SLOPE
TS

Fig. 6-5 Time Chart

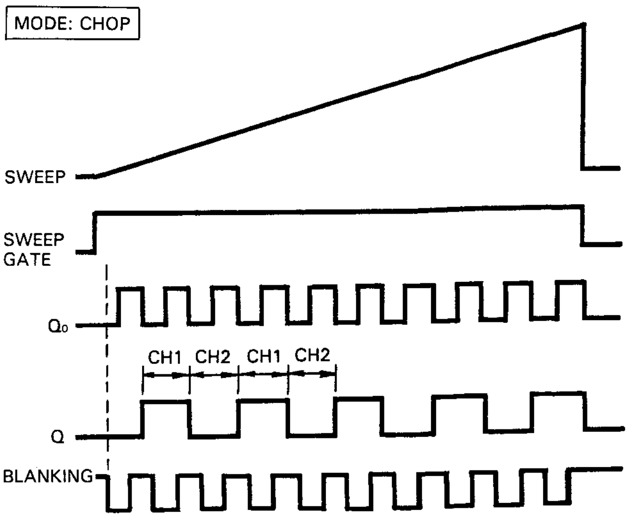

MODE: CHOP
SWEEP
SWEEP GATE
Q0
CH1 CH2 CH1 CH2
Q
BLANKING

Fig. 6-6

## HORIZONTAL AMPLIFIER UNIT

The horizontal amplifier unit is composed of two stages. The front stage of the amplifier, Q5 and Q6 operates the X5 MAG function by selecting the gain. Q1 and Q3 are the switches for the above function. Q2 and Q4 act as the constant current regulator. D6 and D7 act as the clip diodes in order to avoid saturation of the following amplifier stage. The second stage amplifier is composed of Q9-Q12. C11 is the peaking condenser, to improve the high frequency response.

## POWER BLANKING UNIT

Of the six voltage systems output from the switching power circuit, all but the +55 V are doubly stabilized by a series regulator. Q1-Q7 are its control transistors. IC1 and IC2 are the error amplifiers. The CRT high tension voltage is obtained from a DC-DC converter. Q21 is the blocking oscillator and is connected to the converter transformer in P61. 6.3 V, the negative line of −1500 V and the positive line of 4.5 kV are delivered already stabilised. Q17-Q19 act as the error amplifier. The blanking circuit is composed of Q12-Q14, Q23 and Q24. Q15 carries out the switching for these outputs. DC reproduction takes place on the first grid of the CRT. The autofocus circuit is controlled by Q10 and Q11. The blanking waveform and reverse phase signal are added to the focus electrode of the CRT. Q16 is the DC reproduction circuit. Q22 is the external brightness modulator circuit. When the TTL level is high, the brightness of the trace is increased. Q8 and Q9 are the transistors for trace rotation circuit.

# CIRCUIT DESCRIPTION

## CPU CIRCUIT COMPONENTS

### CPU: μPD8085AC (IC11)

Central processing chip of the CPU Board.

### ROM: MB8516ZC or MB2732A (IC6)

Programed Rom. This Rom is FAMOS Type, and 2 kilobytes or 4 kilobytes size.

### RAM: MB8414 (IC2, 5)

For data storage and subroutine stack. The ram is synchronous type CMOS RAM and 1 k×4 bits size.

### ADDRESS LATCH: MB74LS373 (IC8)

The lower 8 bits of the CPU ADDRESS bus is multiplexed with DATA bus, ADDRESS bus is separated by ALE signal from CPU chip. The lower 8 bits of ADDRESS bus is latched by the IC with ALE signal.

### LOW BATTERY LEVEL DETECT CIRCUIT (IC4)

The circuit detects Battery Level down to protect RAM's data. If Battery is down, the circuit send a signal to CPU's RST5.5 terminal, and external signal from Memory pack is same.

### POWER SUPPLY LEVEL DETECTER AND EXTERNAL BATTERY LEVEL DETECT CIRCUIT. (Q3 AND, PIN 11 AND 12 OF IC10)

To protect RAM's DATA, when power switch is operated the circuit disable to access the RAM from CPU. And when power level reach about 4.7 V, the circuit enable to access the RAM.

### ADDRESS DECODER: M74LS138 (IC3), M74LS32 (IC1)

The circuit makes chip enable signals for many circuits, for example on CPU board's RAM ROM, memory pack etc. The circuit also makes signals ANDed $\overline{WR}$ signal for I/O board using IC1.

### PRINTER DRIVER: 2SC536 (Q4)

The circuit transfer signal from CPU's SOD terminal to printer's ports.

### MEMORY DISABLE CIRCUIT: 2SC945 (Q1)

The circuit disable to access to the RAM, when power line level reaches about 4.7 V.

### OTHER CIRCUITS

**(1) IC10 f:**

Buffer for HOLD signal from CPU chip.

**(2) IC10 d:**

When HOLD signal comes high level, IO/$\overline{M}$ signal goes three state.

**(3) IC10 b:**

When HOLD signal comes high level, output $\overline{WR}$ signal from the IC goes three state.

**(4) IC10 a:**

When HOLD signal comes high level, output $\overline{RD}$ signal from the IC goes three state.

**(5) IC 7 b:**

Bus transceiver controll to access from CPU chip to external or internal circuit.

# CIRCUIT DESCRIPTION

## CPU CHIP μPD8085 PIN CONNECTION

| Number | Sign | Function |
|---|---|---|
| 1 | $X_1$ | X Tal connection terminal |
| 2 | $X_2$ | X Tal connection terminal |
| 3 | RESET OUT | For RESET output signal |
| 4 | SOD | Serial data output port |
| 5 | SID | Serial data input port |
| 6 | TRAP | This input is not subject to any mask or interrupt enable/disable instruction. The receipt of a positive-going edge on the TRAP input triggers the processor's hardware interrupt sequence. |
| 7 | RST 7, 5 | Negative edge of input interrupter |
| 8 | RST 6, 5 | High level input interrupter |
| 9 | RST 5, 5 | High level input interrupter |
| 10 | INTR | High level input interrupter |
| 11 | $\overline{\text{INTR}}$ | INTR interrupter |
| 12 | $AD_0$ | Address data of least significant bit LSB |
| 13-19 | $AD_1 \sim AD_7$ | Address data of numbered bits, 1 ~ 7 |
| 20 | Vss | GND terminal |
| 21-27 | $A_8 \sim A_{14}$ | Bit address data, 8 ~ 14 |
| 28 | $A_{15}$ | Address data of most significant bit MSB |
| 29 | $S_0$ | Status signal (refer to Table 6-2) |
| 30 | ALE | Address latch negative edge signal |
| 31 | $\overline{\text{WR}}$ | Address latch positive edge signal |
| 32 | $\overline{\text{RD}}$ | CPU-BUS read signal |
| 33 | $S_1$ | Status signal (refer to another fig) |
| 34 | IO/$\overline{\text{M}}$ | Memory I/O select signal memory (memory select in low level) |
| 35 | READY | Signal for temporary stop of CPU (stop in low level) |
| 36 | $\overline{\text{RESET IN}}$ | RESET input signal (RESET in low level) |
| 37 | CLK | CPU CLK output terminal |
| 38 | HLDA | CPU HOLD acknowledge signal |
| 39 | HOLD | HOLD require signal from CPU |
| 40 | Vcc | +5V |

Table 6-1

## CPU STATUS

| Terminal | IO/$\overline{\text{M}}$ | $S_1$ | $S_0$ | Status |
|---|---|---|---|---|
|  | 0 | 0 | 1 | WRITE to MEMORY |
|  | 0 | 1 | 0 | READ from MEMORY |
|  | 1 | 0 | 1 | Write to I/O |
|  | 1 | 1 | 0 | READ from I/O |
|  | 0 | 1 | 1 | FETCH of OPE code |
|  | 1 | 1 | 1 | Acknowledgement of INTERRUPT |
|  | / | 0 | 0 | HALT |

Table 6-2

## M$\mu$8516 ZC PIN CONNECTION

| Pin Number | Sign | Function |
|---|---|---|
| 1-8 | $A_7$-$A_0$ | Address bits, 7-0 |
| 9-11 | $D_0$-$D_2$ | DATA bits 0-bits, 2 |
| 12 | GND | GND terminal |
| 13-17 | $D_3$-$D_7$ | DATA bits, 3-7 |
| 18 | $\overline{\text{CE}}$ | Chip Select signal (in low level) |
| 19 | $A_{10}$ | Address bit, 10 |
| 20 | $\overline{\text{OE}}$ | Signal to open output buffer of PROM |
| 21 | Vpp | Programme voltage terminal |
| 22 | $A_9$ | Address bit, 9 |
| 23 | $A_8$ | Address bit, 8 |
| 24 | Vcc | Power supply terminal |

Table 6-3

### Voltage value of each component

Power supply..................5 V ±5%
Battery voltage...............2.7 V-3.4 V
Zenner diode ..................D3, approx 2.8 V

**CPU μPD8085 Output frequency from P37**
1.793 MHz ±5%

### CPU Terminal Levels in Normal Operation

TRAP terminal ................LOW
RST 6.5 ........................LOW (High level when battery power is low)
HLDA...........................LOW
RST 5.5 ........................LOW (HIGH with operation of key)

Other terminals are dynamic operation.

# CIRCUIT DESCRIPTION

## I/O CIRCUIT COMPONENT

Oscilloscope control port: M74LS374
Input port from panel switch: M74LS373
7 segments LED indication port: TC4511
Output port decoder: M74LS138
Input port decoder: M74LS138
Key board driver port: M74LS196
Key board input port: M74LS126
Buzzer step sequence LED port: M74LS374
Auxiliary logic circuit: M74LS02

### MEMORY MAP

| | READ | WRITE |
|---|---|---|
| 0 ~ 0FFF | PROM | |
| 1000 ~ 13FF | RAM | RAM |
| 3000 | | KEY DRIVE PORT |
| 4000 | | 7 SEGMENTS LED INDICATION PORT |
| 5000 | | STEP SEQUENCE BUZER LED PORT |
| 6000 | KEY BOARD RETURN | MEMORY PACK RESET |
| 7000 | MEMORY PACK DATA | MEMORY PACK DATA |
| 8000 ~ 800F | OSCILLOSCOPE CONTROL PORT | OSCILLOSCOPE CONTROL PORT |

Note: Involves FF 16 expansion version

Table 6-4

## KEYBOARD UNIT

Located in RT-1721 control unit
Using IC units, SN74LS148
To encode the signal from the keyboard.

### OPERATION

The drive signal originates from the I/O board of the main body (refer to Fig. 6-7). This signal is the input from P03, and if the key is not pushed, then the output signal from P09 is in high level at KD0-KD2, and at KD3 it is in low level. When the key is operated, the level of KD3 is raised to high, and the code corresponding to the key is output at KD0-KD2. This P03 key drive signal is cancelled. (refer to Table 6-5)

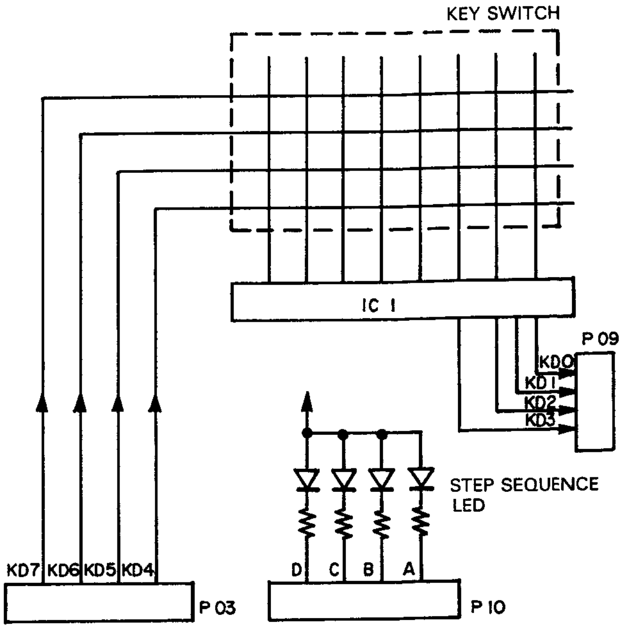
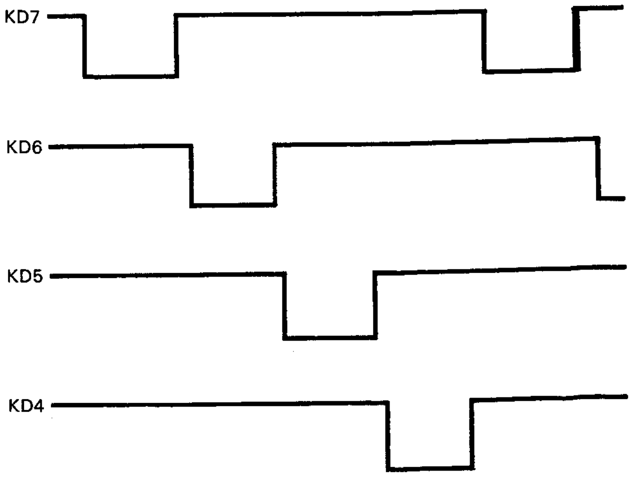


Fig. 6-7



Note: The software preset the timing, therefore timing is not constant as shown. When the key is depressed, the level of the key drive line is raised to high level.

Fig. 6-8

# CIRCUIT DESCRIPTION

## MEMORY PACK OPERATION

**BUS TRANSCEIVER**

Buffer between main body of CS-1720/and memory

**MEMORY**

**COUNTER**

Counter deciding memory address

**OTHER CONTROL CIRCUITS**

**TC4001**

Pins 9, 10, 11

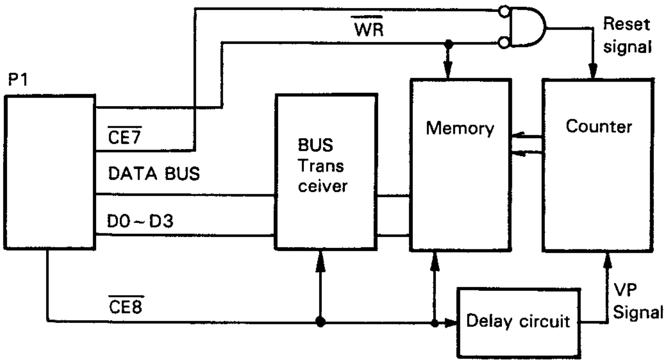
Clock for address counter

Pins 1, 2, 3

Counter RESET signal

**TL061**

Backup battery monitor

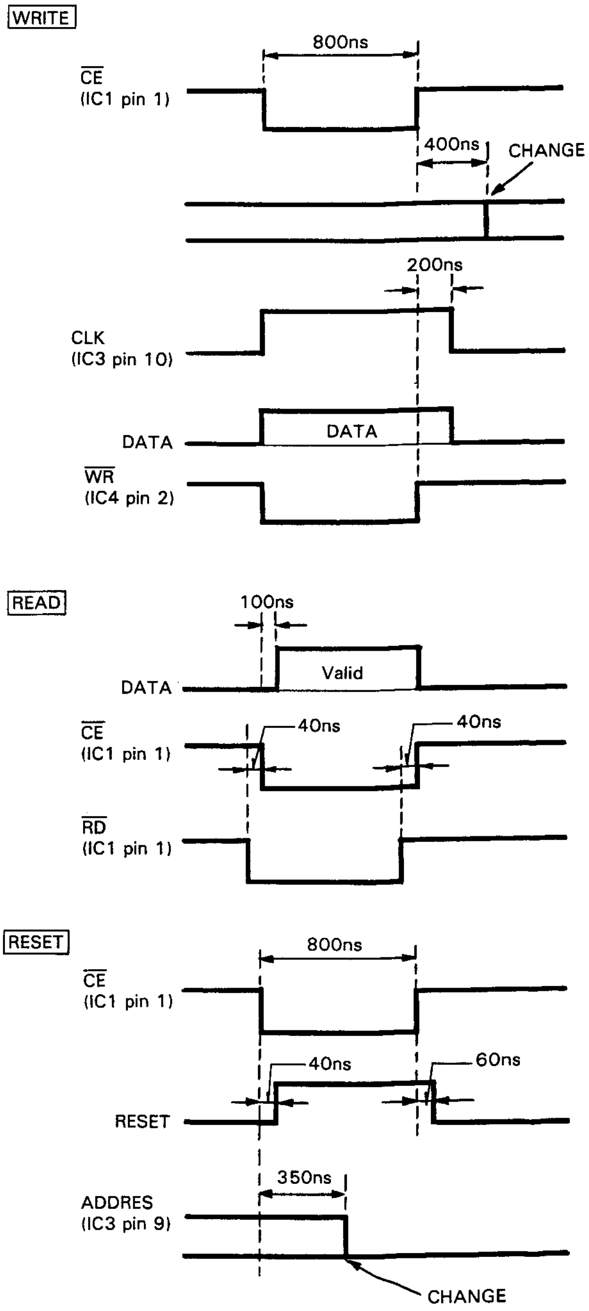


WR
Reset
signal
P1
CE7
DATA BUS
D0~D3
BUS
Trans
ceiver
Memory
Counter
VP
Signal
CE8
Delay circuit

Fig. 6-9

| KD0 | KD1 | KD2 | Corresponding key |
|---|---|---|---|
| 0 | 0 | 0 | A, STO, 7 |
| 1 | 0 | 0 | S24, DOWN, READ, 6 |
| 0 | 1 | 0 | S23, D, ALL WRT, 5 |
| 1 | 1 | 0 | PRNT, SCAN, PART WRT, 4 |
| 0 | 0 | 1 | SAVE, UP, END, 3 |
| 1 | 0 | 1 | LOAD, RST, START, 2 |
| 0 | 1 | 1 | EXT, C, 9, 1 |
| 1 | 1 | 1 | FREE, B, 8, 0 |

Table 6-5

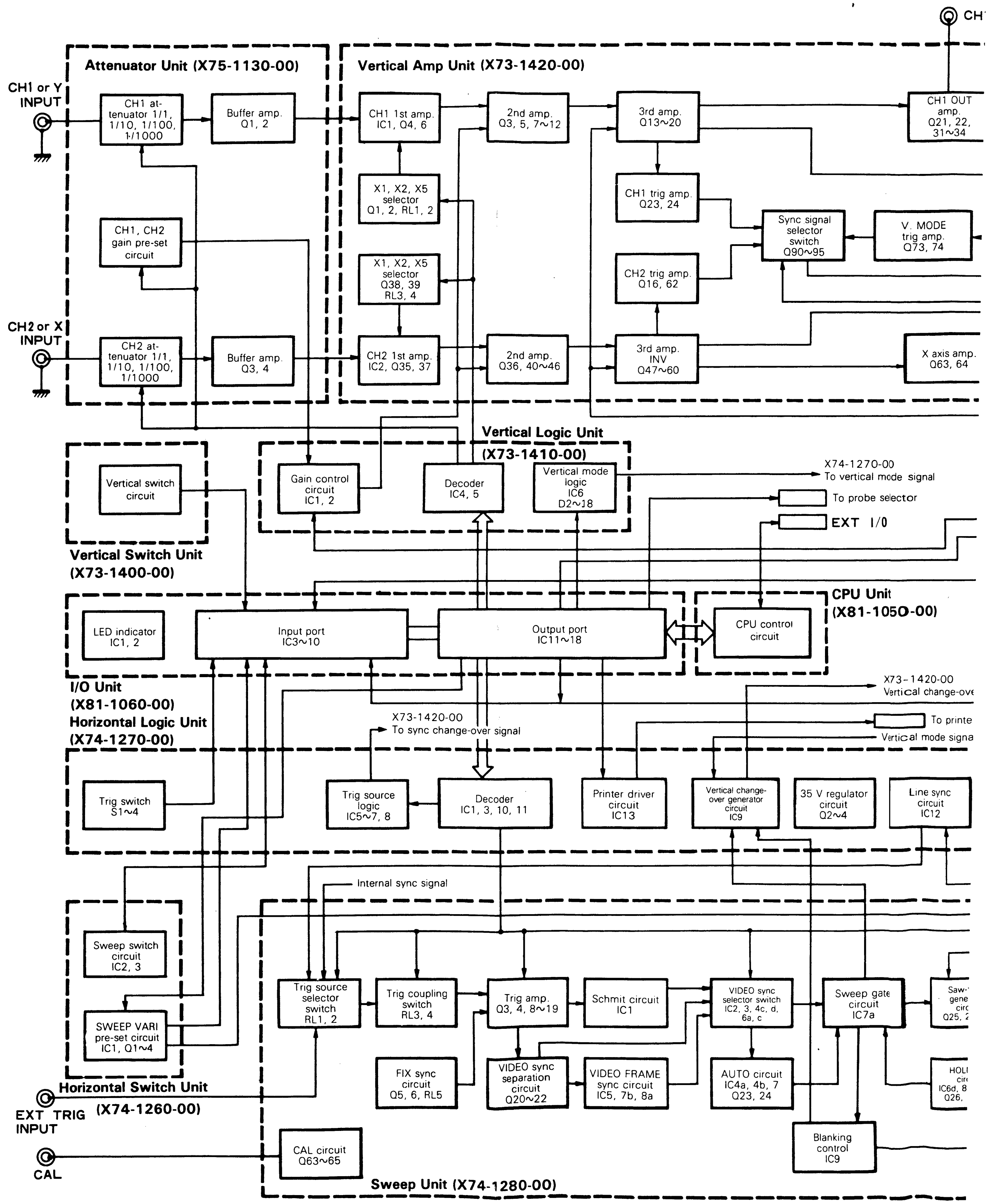


WRITE
800ns
CE
(IC1 pin 1)
400ns
CHANGE
200ns
CLK
(IC3 pin 10)
DATA
DATA
WR
(IC4 pin 2)
READ
100ns
DATA
Valid
CE
(IC1 pin 1)
40ns
40ns
RD
(IC1 pin 1)
RESET
800ns
CE
(IC1 pin 1)
40ns
60ns
RESET
350ns
ADDRES
(IC3 pin 9)
CHANGE

Fig. 6-10 Memory pack Timing

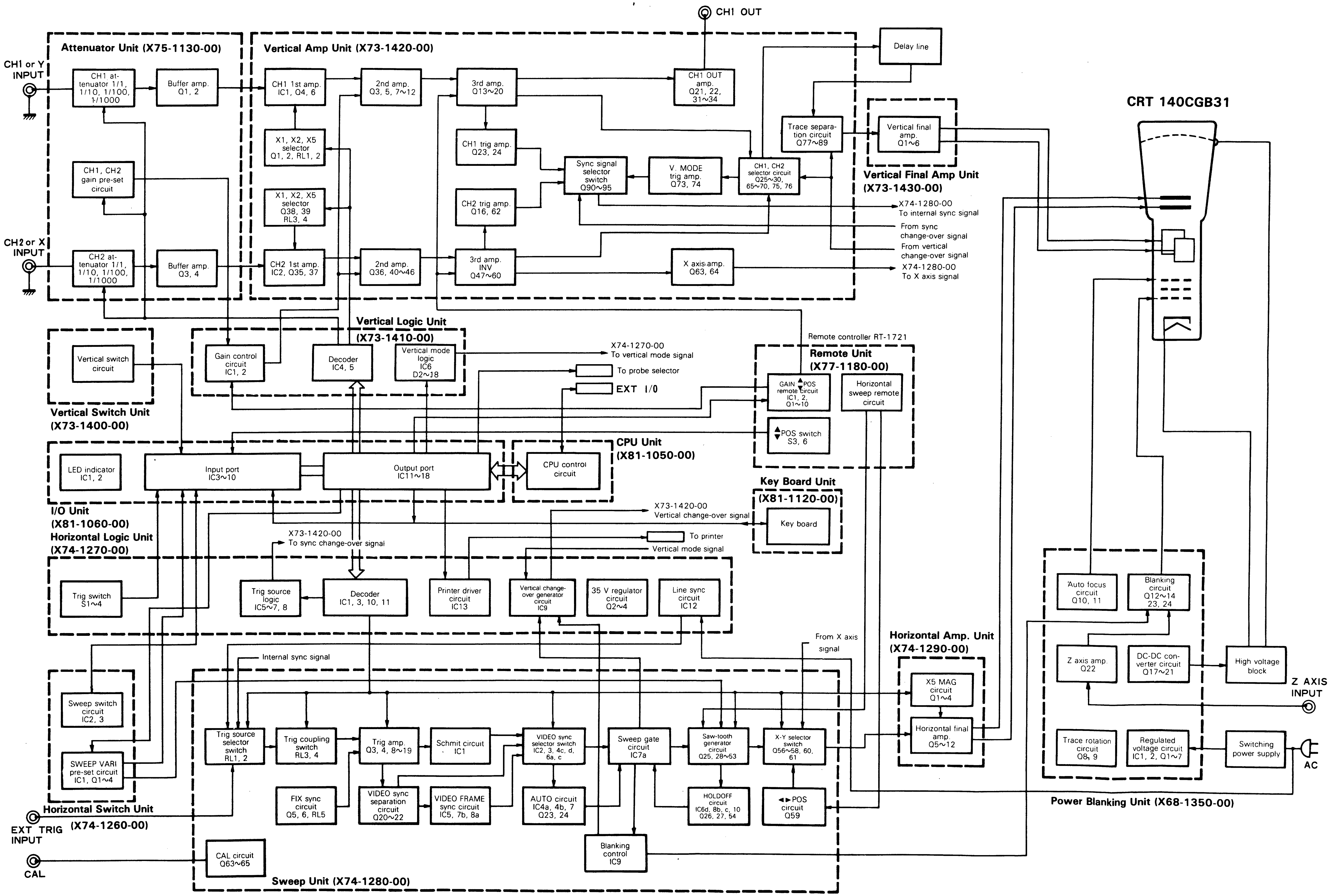
# CIRCUIT DESCR

## BLOCK DIAGR


CH
Attenuator Unit (X75-1130-00)
Vertical Amp Unit (X73-1420-00)
CH1 or Y INPUT
CH1 attenuator 1/1, 1/10, 1/100, 1/1000
Buffer amp. Q1, 2
CH1 1st amp. IC1, Q4, 6
2nd amp. Q3, 5, 7~12
3rd amp. Q13~20
CH1 OUT amp. Q21, 22, 31~34
X1, X2, X5 selector Q1, 2, RL1, 2
CH1 trig amp. Q23, 24
Sync signal selector switch Q90~95
V. MODE trig amp. Q73, 74
CH1, CH2 gain pre-set circuit
X1, X2, X5 selector Q38, 39 RL3, 4
CH2 trig amp. Q16, 62
CH2 or X INPUT
CH2 attenuator 1/1, 1/10, 1/100, 1/1000
Buffer amp. Q3, 4
CH2 1st amp. IC2, Q35, 37
2nd amp. Q36, 40~46
3rd amp. INV Q47~60
X axis amp. Q63, 64
Vertical Logic Unit (X73-1410-00)
Vertical switch circuit
Gain control circuit IC1, 2
Decoder IC4, 5
Vertical mode logic IC6 D2~18
X74-1270-00 To vertical mode signal
To probe selector
EXT I/0
Vertical Switch Unit (X73-1400-00)
CPU Unit (X81-1050-00)
LED indicator IC1, 2
Input port IC3~10
Output port IC11~18
CPU control circuit
I/O Unit (X81-1060-00)
Horizontal Logic Unit (X74-1270-00)
X73-1420-00 Vertical change-ove
X73-1420-00 To sync change-over signal
To printe
Vertical mode signa
Trig switch S1~4
Trig source logic IC5~7, 8
Decoder IC1, 3, 10, 11
Printer driver circuit IC13
Vertical change-over generator circuit IC9
35 V regulator circuit Q2~4
Line sync circuit IC12
Internal sync signal
Sweep switch circuit IC2, 3
SWEEP VARI pre-set circuit IC1, Q1~4
Trig source selector switch RL1, 2
Trig coupling switch RL3, 4
Trig amp. Q3, 4, 8~19
Schmit circuit IC1
VIDEO sync selector switch IC2, 3, 4c, d, 6a, c
Sweep gate circuit IC7a
Saw- gene circ Q25, 2
FIX sync circuit Q5, 6, RL5
VIDEO sync separation circuit Q20~22
VIDEO FRAME sync circuit IC5, 7b, 8a
AUTO circuit IC4a, 4b, 7 Q23, 24
HOL circ IC6d, 8 Q26,
Horizontal Switch Unit (X74-1260-00)
EXT TRIG INPUT
Blanking control IC9
CAL circuit Q63~65
CAL
Sweep Unit (X74-1280-00)

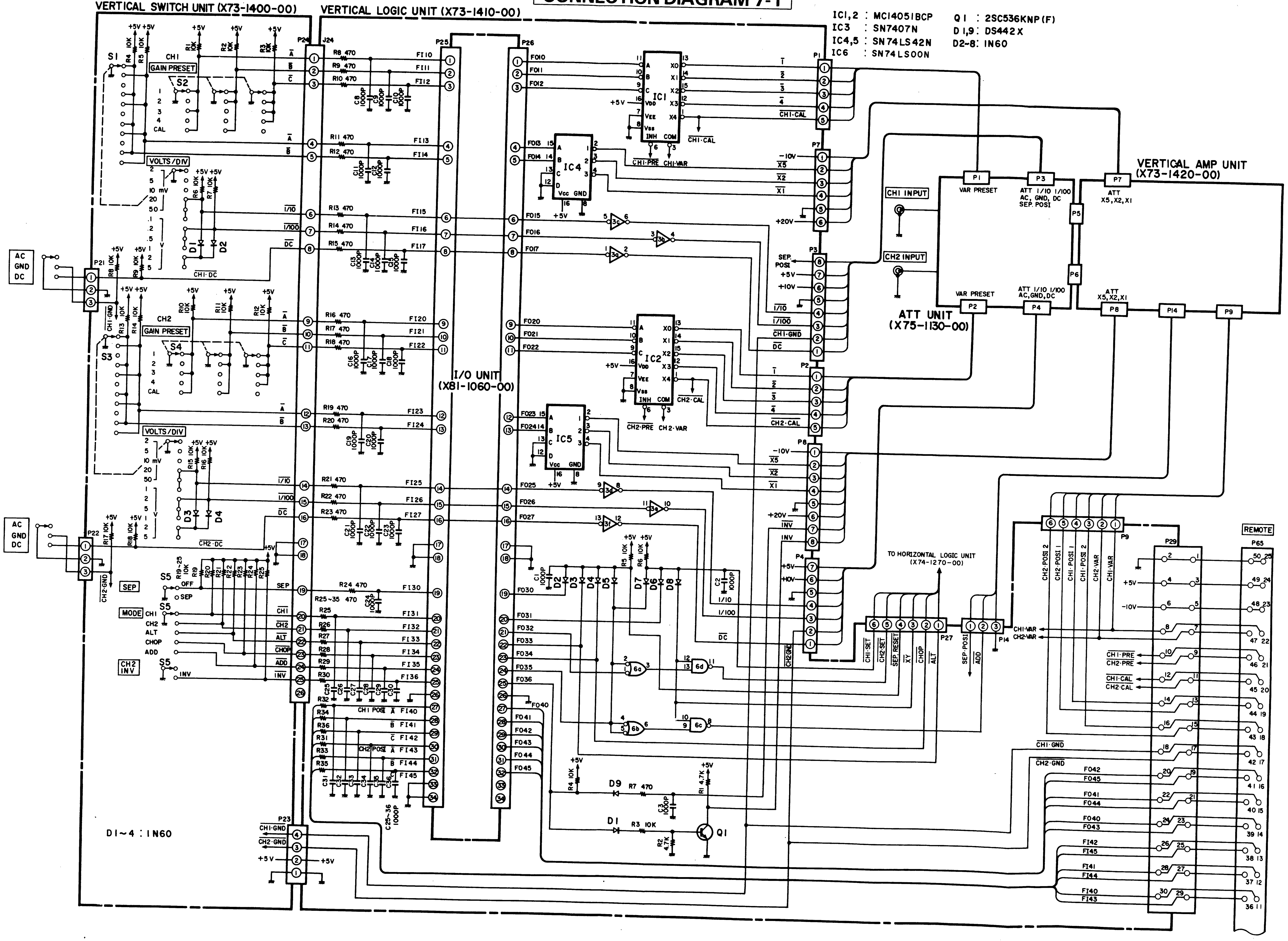
# CIRCUIT DESCRIPTION

## BLOCK DIAGRAM


CH1 OUT
Attenuator Unit (X75-1130-00)
CH1 or Y INPUT
CH1 at-tenuator 1/1, 1/10, 1/100, 1/1000
Buffer amp. Q1, 2
CH1, CH2 gain pre-set circuit
CH2 or X INPUT
CH2 at-tenuator 1/1, 1/10, 1/100, 1/1000
Buffer amp. Q3, 4
Vertical Amp Unit (X73-1420-00)
CH1 1st amp. IC1, Q4, 6
2nd amp. Q3, 5, 7~12
3rd amp. Q13~20
CH1 OUT amp. Q21, 22, 31~34
X1, X2, X5 selector Q1, 2, RL1, 2
CH1 trig amp. Q23, 24
X1, X2, X5 selector Q38, 39 RL3, 4
CH2 trig amp. Q16, 62
Sync signal selector switch Q90~95
V. MODE trig amp. Q73, 74
CH1, CH2 selector circuit Q25~30, 65~70, 75, 76
CH2 1st amp. IC2, Q35, 37
2nd amp. Q36, 40~46
3rd amp. INV Q47~60
X axis amp. Q63, 64
Delay line
Trace separa-tion circuit Q77~89
Vertical final amp. Q1~6
Vertical Final Amp Unit (X73-1430-00)
X74-1280-00 To internal sync signal
From sync change-over signal
From vertical change-over signal
X74-1280-00 To X axis signal
CRT 140CGB31
Vertical Logic Unit (X73-1410-00)
Vertical switch circuit
Vertical Switch Unit (X73-1400-00)
Gain control circuit IC1, 2
Decoder IC4, 5
Vertical mode logic IC6 D2~18
X74-1270-00 To vertical mode signal
To probe selector
EXT I/O
Remote controller RT-1721
Remote Unit (X77-1180-00)
GAIN POS remote circuit IC1, 2, Q1~10
Horizontal sweep remote circuit
POS switch S3, 6
LED indicator IC1, 2
Input port IC3~10
Output port IC11~18
CPU control circuit
CPU Unit (X81-1050-00)
I/O Unit (X81-1060-00)
Key Board Unit (X81-1120-00)
Key board
X73-1420-00 Vertical change-over signal
Horizontal Logic Unit (X74-1270-00)
X73-1420-00 To sync change-over signal
To printer
Vertical mode signal
Trig switch S1~4
Trig source logic IC5~7, 8
Decoder IC1, 3, 10, 11
Printer driver circuit IC13
Vertical change-over generator circuit IC9
35 V regulator circuit Q2~4
Line sync circuit IC12
From X axis signal
Horizontal Amp. Unit (X74-1290-00)
X5 MAG circuit Q1~4
Horizontal final amp. Q5~12
Internal sync signal
Sweep switch circuit IC2, 3
SWEEP VARI pre-set circuit IC1, Q1~4
Horizontal Switch Unit (X74-1260-00)
EXT TRIG INPUT
CAL
Trig source selector switch RL1, 2
Trig coupling switch RL3, 4
Trig amp. Q3, 4, 8~19
Schmit circuit IC1
VIDEO sync selector switch IC2, 3, 4c, d, 6a, c
Sweep gate circuit IC7a
Saw-tooth generator circuit Q25, 28~53
X-Y selector switch Q56~58, 60, 61
FIX sync circuit Q5, 6, RL5
VIDEO sync separation circuit Q20~22
VIDEO FRAME sync circuit IC5, 7b, 8a
AUTO circuit IC4a, 4b, 7 Q23, 24
HOLDOFF circuit IC6d, 8b, c, 10 Q26, 27, 54
POS circuit Q59
Blanking control IC9
CAL circuit Q63~65
Sweep Unit (X74-1280-00)
Auto focus circuit Q10, 11
Blanking circuit Q12~14 23, 24
Z axis amp. Q22
DC-DC con-verter circuit Q17~21
High voltage block
Z AXIS INPUT
Trace rotation circuit Q8, 9
Regulated voltage circuit IC1, 2, Q1~7
Switching power supply
AC
Power Blanking Unit (X68-1350-00)

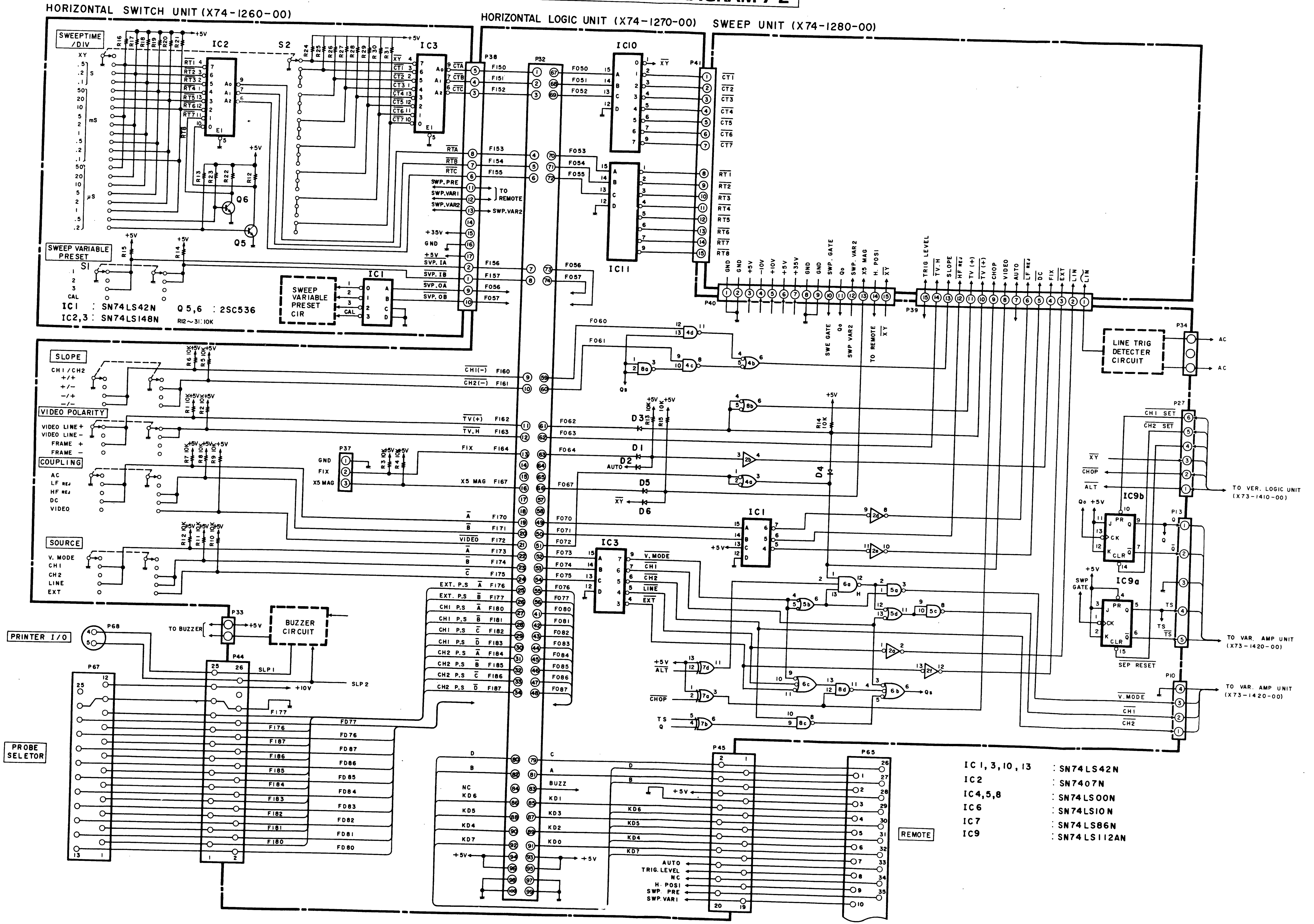
# CIRCUIT DESCRIPTION

## CONNECTION DIAGRAM 7-1


IC1,2 : MC14051BCP
IC3 : SN7407N
IC4,5 : SN74LS42N
IC6 : SN74LS00N
Q1 : 2SC536KNP(F)
D1,9 : DS442X
D2-8 : 1N60
VERTICAL SWITCH UNIT (X73-1400-00)
VERTICAL LOGIC UNIT (X73-1410-00)
I/O UNIT (X81-1060-00)
VERTICAL AMP UNIT (X73-1420-00)
ATT UNIT (X75-1130-00)
TO HORIZONTAL LOGIC UNIT (X74-1270-00)
REMOTE
P65
CH1 INPUT
CH2 INPUT
VAR PRESET
ATT 1/10 1/100 AC, GND, DC SEP. POSI
ATT X5, X2, X1
GAIN PRESET
VOLTS/DIV
AC GND DC
CH1 GAIN PRESET
CH2 GAIN PRESET
S1
S2
S3
S4
S5
SEP
MODE
CH2 INV
CH1
CH2
ALT
CHOP
ADD
OFF
INV
CAL
CH1·DC
CH2·DC
CH1·GND
CH2·GND
CH1·CAL
CH2·CAL
CH1·PRE
CH2·PRE
CH1·VAR
CH2·VAR
CH1·SET
CH2·SET
SEP. RESET
X·Y
SEP. POSI
CH1·POSI 1
CH1·POSI 2
CH2·POSI 1
CH2·POSI 2
IC1
IC2
IC4
IC5
Q1
+5V
-10V
+10V
+20V
D1~4 : 1N60
C25~36 1000P
P1
P2
P3
P4
P5
P6
P7
P8
P9
P14
P21
P22
P23
P24
P25
P26
P27
P29
J24

# CIRCUIT DESCRIPTION

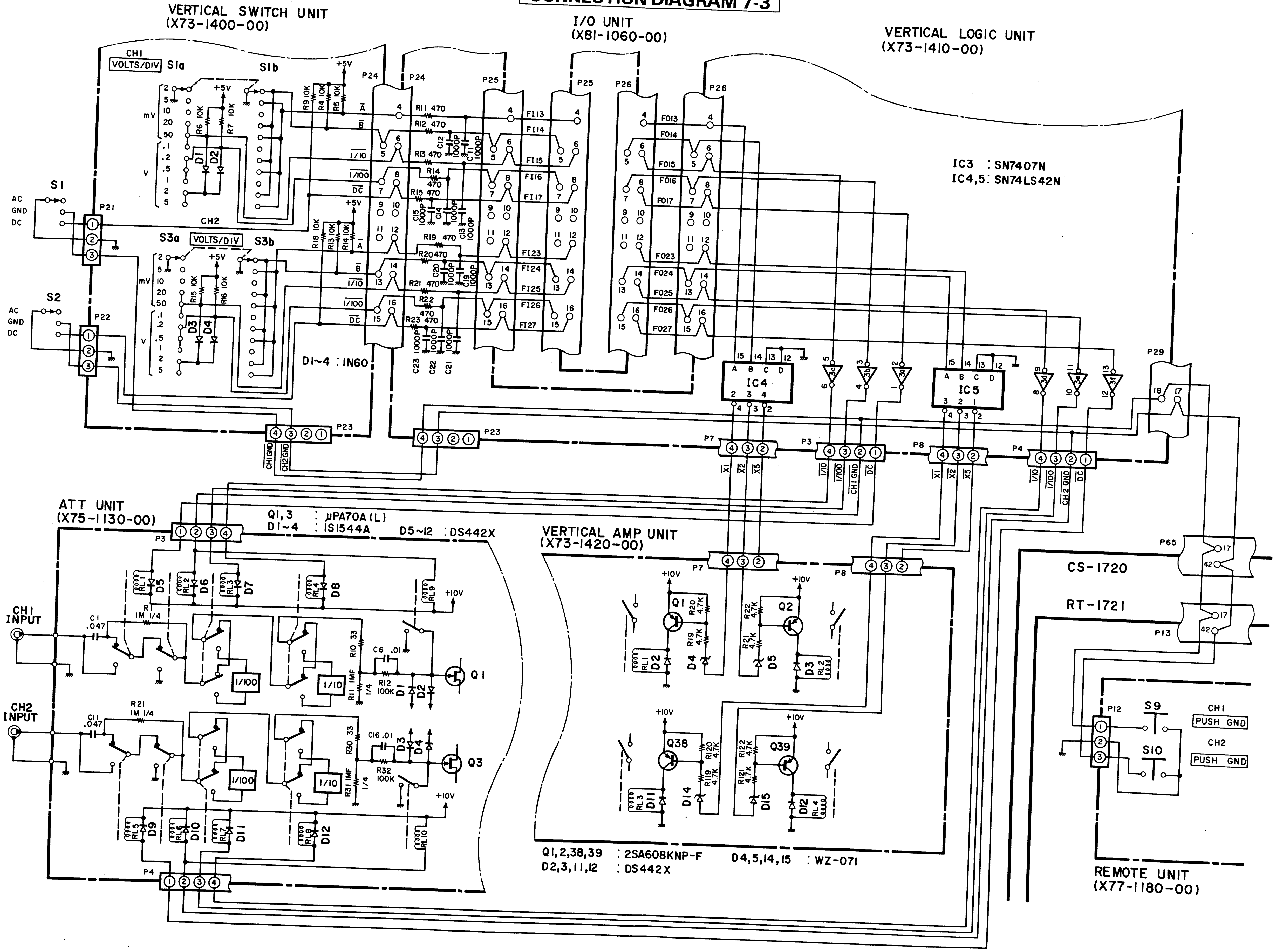
## CONNECTION DIAGRAM 7-2



HORIZONTAL SWITCH UNIT (X74-1260-00)
HORIZONTAL LOGIC UNIT (X74-1270-00)
SWEEP UNIT (X74-1280-00)
SWEEPTIME /DIV
SWEEP VARIABLE PRESET
S1
S2
IC1
IC2
IC3
Q5
Q6
SWEEP VARIABLE PRESET CIR
IC1 : SN74LS42N
IC2,3 : SN74LS148N
Q5,6 : 2SC536
R12~31: 10K
SLOPE
VIDEO POLARITY
COUPLING
SOURCE
P38
P32
P41
P40
P39
P34
P27
P13
P10
P37
P33
P44
P45
P65
P67
P68
IC10
IC11
IC9a
IC9b
D1
D2
D3
D4
D5
D6
LINE TRIG DETECTER CIRCUIT
BUZZER CIRCUIT
TO BUZZER
PRINTER I/O
PROBE SELETOR
REMOTE
TO REMOTE
TO VER. LOGIC UNIT (X73-1410-00)
TO VAR. AMP UNIT (X73-1420-00)
TO VAR. AMP UNIT (X73-1420-00)
AC
AC
IC1,3,10,13 : SN74LS42N
IC2 : SN7407N
IC4,5,8 : SN74LS00N
IC6 : SN74LS10N
IC7 : SN74LS86N
IC9 : SN74LS112AN

# CIRCUIT DESCRIPTION

## CONNECTION DIAGRAM 7-3

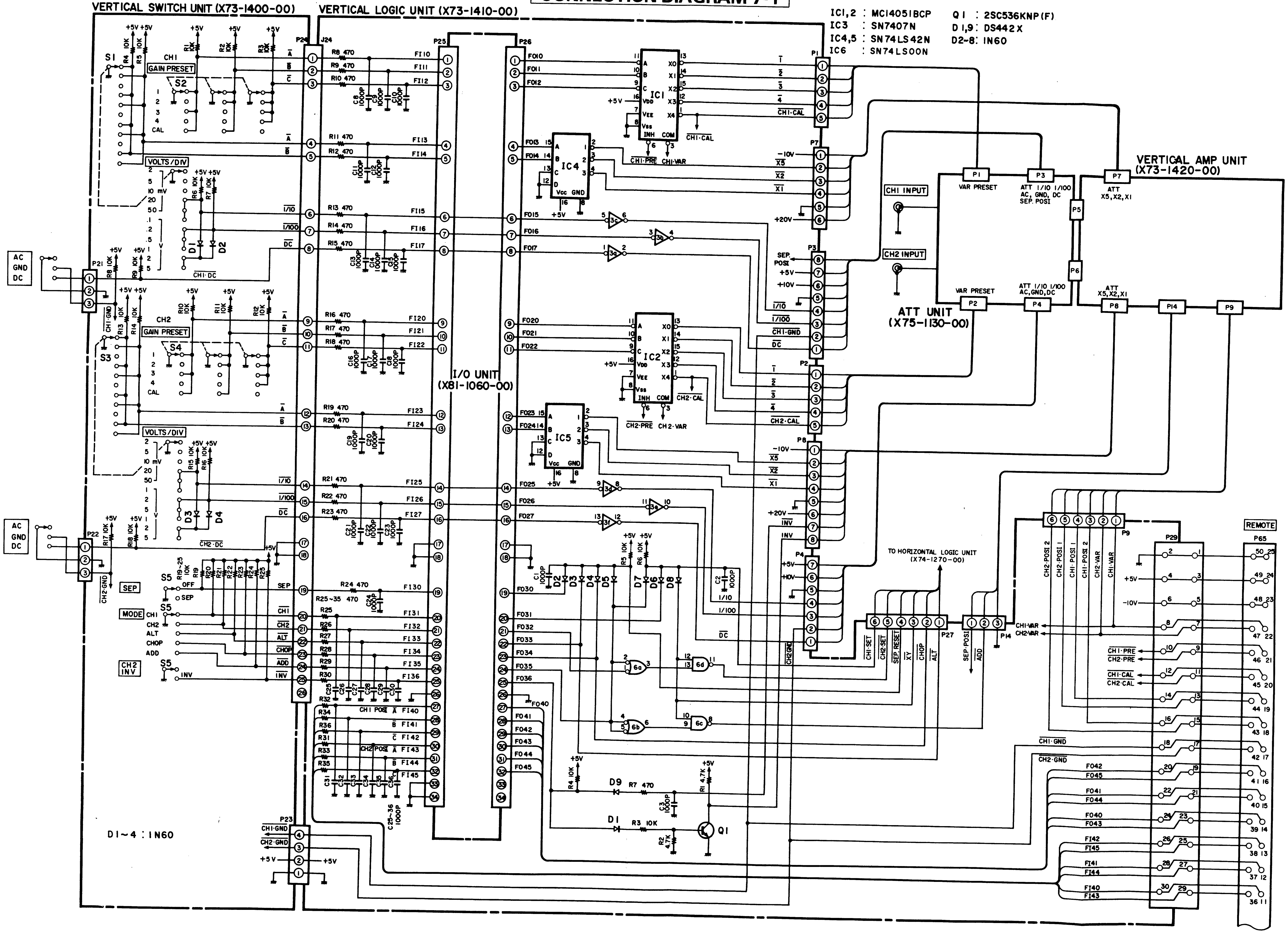

VERTICAL SWITCH UNIT
(X73-1400-00)
I/O UNIT
(X81-1060-00)
VERTICAL LOGIC UNIT
(X73-1410-00)
CH1
VOLTS/DIV
S1a
S1b
+5V
mV
V
10
20
50
.1
.2
.5
1
2
5
R6 10K
R7 10K
D1
D2
R9 10K
R4 10K
R5 10K
P24
P25
P26
R11 470
R12 470
R13 470
R14 470
R15 470
R19 470
R20 470
R21 470
R22 470
R23 470
C11 1000P
C12 1000P
C13 1000P
C14 1000P
C15 1000P
C19 1000P
C20 1000P
C21 1000P
C22 1000P
C23 1000P
F113
F114
F115
F116
F117
F123
F124
F125
F126
F127
F013
F014
F015
F016
F017
F023
F024
F025
F026
F027
IC3 : SN7407N
IC4,5: SN74LS42N
S1
AC
GND
DC
P21
CH2
S3a
S3b
R15 10K
R16 10K
R18 10K
R13 10K
R14 10K
D3
D4
S2
P22
D1~4 : IN60
A
B
1/10
1/100
DC
IC4
IC5
P29
P23
CH1GND
CH2GND
P7
P3
P8
P4
X1
X2
X5
CH1 GND
CH 2 GND
ATT UNIT
(X75-1130-00)
Q1,3 : μPA70A (L)
D1~4 : 1S1544A
D5~12 : DS442X
CH1 INPUT
CH2 INPUT
C1 .047
C11 .047
R1 1M 1/4
R21 1M 1/4
RL1
RL2
RL3
RL4
RL5
RL6
RL7
RL8
RL9
RL10
D5
D6
D7
D8
D9
D10
D11
D12
+10V
1/100
1/10
R10 33
R30 33
C6 .01
C16 .01
R11 1MF 1/4
R31 1MF 1/4
R12 100K
R32 100K
Q1
Q3
VERTICAL AMP UNIT
(X73-1420-00)
R19 4.7K
R20 4.7K
R21 4.7K
R22 4.7K
R119 4.7K
R120 4.7K
R121 4.7K
R122 4.7K
Q2
Q38
Q39
D14
D15
Q1,2,38,39 : 2SA608KNP-F
D2,3,11,12 : DS442X
D4,5,14,15 : WZ-071
CS-1720
RT-1721
P65
P13
P12
S9
S10
PUSH GND
REMOTE UNIT
(X77-1180-00)

# CIRCUIT DESCRIPTION

## CONNECTION DIAGRAM 7-1

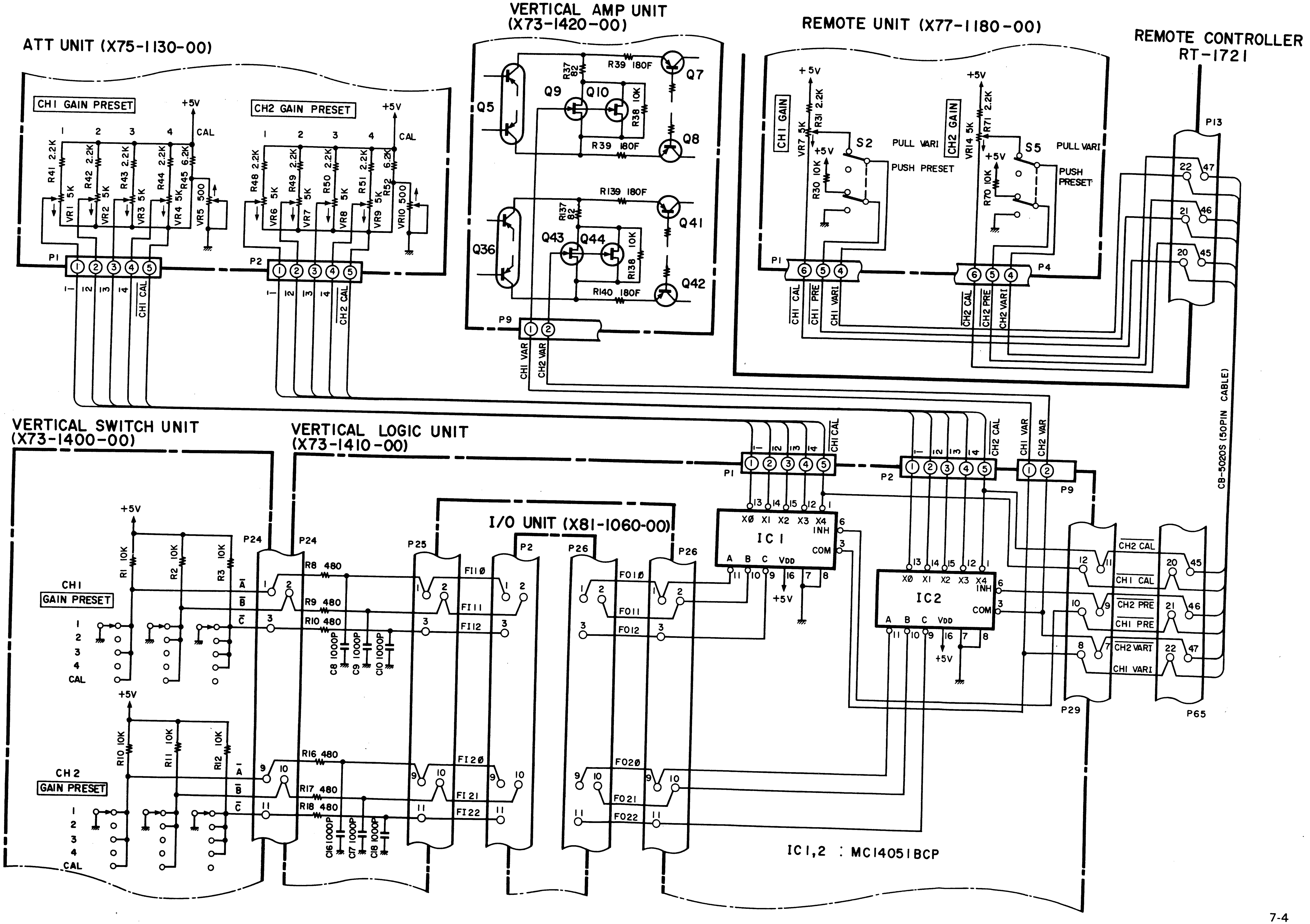
IC1,2 : MC14051BCP
IC3 : SN7407N
IC4,5 : SN74LS42N
IC6 : SN74LS00N

Q1 : 2SC536KNP(F)
D1,9 : DS442X
D2~8 : 1N60



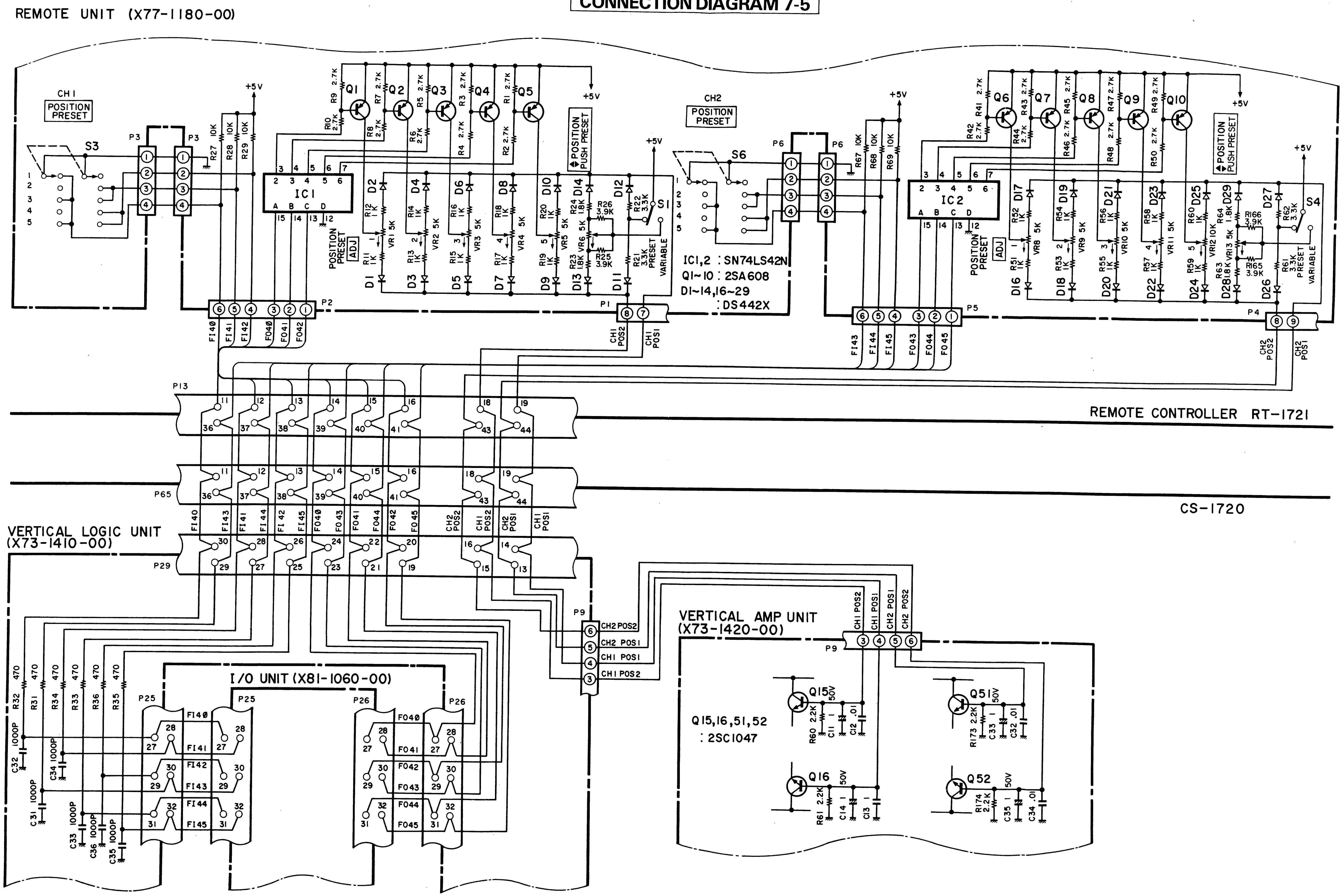
VERTICAL SWITCH UNIT (X73-1400-00)
VERTICAL LOGIC UNIT (X73-1410-00)
I/O UNIT (X81-1060-00)
VERTICAL AMP UNIT (X73-1420-00)
ATT UNIT (X75-1130-00)
CH1 INPUT
CH2 INPUT
TO HORIZONTAL LOGIC UNIT (X74-1270-00)
REMOTE
AC GND DC
CH1 GAIN PRESET
CH2 GAIN PRESET
VOLTS/DIV
SEP
MODE
CH2 INV
S1
S2
S3
S4
S5
IC1
IC2
IC4
IC5
Q1
P1
P2
P3
P4
P5
P6
P7
P8
P9
P14
P21
P22
P23
P24
P25
P26
P27
P29
P65
J24
VAR PRESET
ATT 1/10 1/100 AC, GND, DC SEP. POSI
ATT X5,X2,X1
D1~4 : 1N60

## CONNECTION DIAGRAM 7-4


ATT UNIT (X75-1130-00)
CH1 GAIN PRESET
CH2 GAIN PRESET
+5V
CAL
R41 2.2K
R42 2.2K
R43 2.2K
R44 2.2K
R45 6.2K
VR1 5K
VR2 5K
VR3 5K
VR4 5K
VR5 500
R48 2.2K
R49 2.2K
R50 2.2K
R51 2.2K
R52 6.2K
VR6 5K
VR7 5K
VR8 5K
VR9 5K
VR10 500
P1
P2
CH1 CAL
CH2 CAL
VERTICAL AMP UNIT (X73-1420-00)
Q5
Q7
Q8
Q9
Q10
R37 82
R38 10K
R39 180F
Q36
Q41
Q42
Q43
Q44
R137 82
R138 10K
R139 180F
R140 180F
P9
CH1 VAR
CH2 VAR
REMOTE UNIT (X77-1180-00)
CH1 GAIN
CH2 GAIN
VR7 5K
R31 2.2K
R30 10K
S2
PULL VARI
PUSH PRESET
VR14 5K
R71 2.2K
R70 10K
S5
CH1 PRE
CH1 VARI
CH2 PRE
CH2 VARI
P4
REMOTE CONTROLLER RT-1721
P13
CB-5020S (50PIN CABLE)
VERTICAL SWITCH UNIT (X73-1400-00)
CH1 GAIN PRESET
CH2 GAIN PRESET
R1 10K
R2 10K
R3 10K
R10 10K
R11 10K
R12 10K
P24
VERTICAL LOGIC UNIT (X73-1410-00)
R8 480
R9 480
R10 480
R16 480
R17 480
R18 480
C8 1000P
C9 1000P
C10 1000P
C16 1000P
C17 1000P
C18 1000P
P25
I/O UNIT (X81-1060-00)
P26
FI10
FI11
FI12
FI20
FI21
FI22
FO10
FO11
FO12
FO20
FO21
FO22
IC1
IC2
X0 X1 X2 X3 X4
INH
COM
A B C VDD
P29
P65
IC1,2 : MC14051BCP

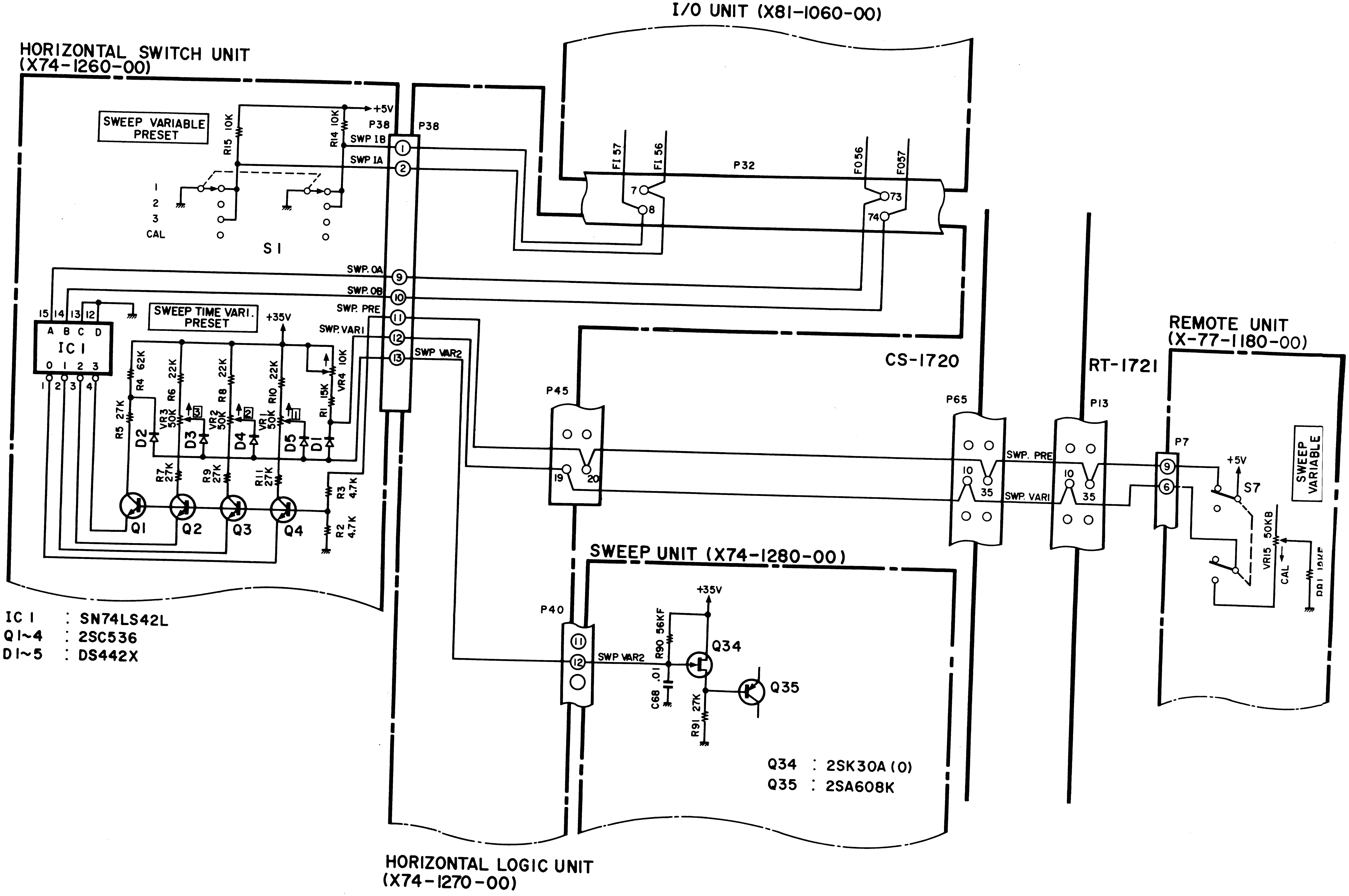
# CIRCUIT DESCRIPTION

## CONNECTION DIAGRAM 7-5


REMOTE UNIT (X77-1180-00)
CH1 POSITION PRESET
S3
P3
+5V
R27 10K
R28 10K
R29 10K
IC1
Q1
Q2
Q3
Q4
Q5
POSITION PUSH PRESET
POSITION PRESET ADJ
VR1 5K
VR2 5K
VR3 5K
VR4 5K
VR5 5K
VR6 5K
S1
PRESET
VARIABLE
IC1,2 : SN74LS42N
Q1~10 : 2SA608
D1~14,16~29 : DS442X
P2
P1
CH1 POS2
CH1 POS1
CH2 POSITION PRESET
S6
P6
R67 10K
R68 10K
R69 10K
IC2
Q6
Q7
Q8
Q9
Q10
S4
P5
P4
CH2 POS2
CH2 POS1
F140
F141
F142
F040
F041
F042
F143
F144
F145
F043
F044
F045
P13
REMOTE CONTROLLER RT-1721
P65
CS-1720
VERTICAL LOGIC UNIT (X73-1410-00)
P29
P9
CH2 POS2
CH2 POS1
CH1 POS1
CH1 POS2
I/O UNIT (X81-1060-00)
P25
P26
VERTICAL AMP UNIT (X73-1420-00)
Q15
Q16
Q51
Q52
Q15,16,51,52 : 2SC1047
R32 470
R31 470
R34 470
R33 470
R36 470
R35 470
C32 1000P
C34 1000P
C31 1000P
C33 1000P
C36 1000P
C35 1000P

# CIRCUIT DESCRIPTION

## CONNECTION DIAGRAM 7-6

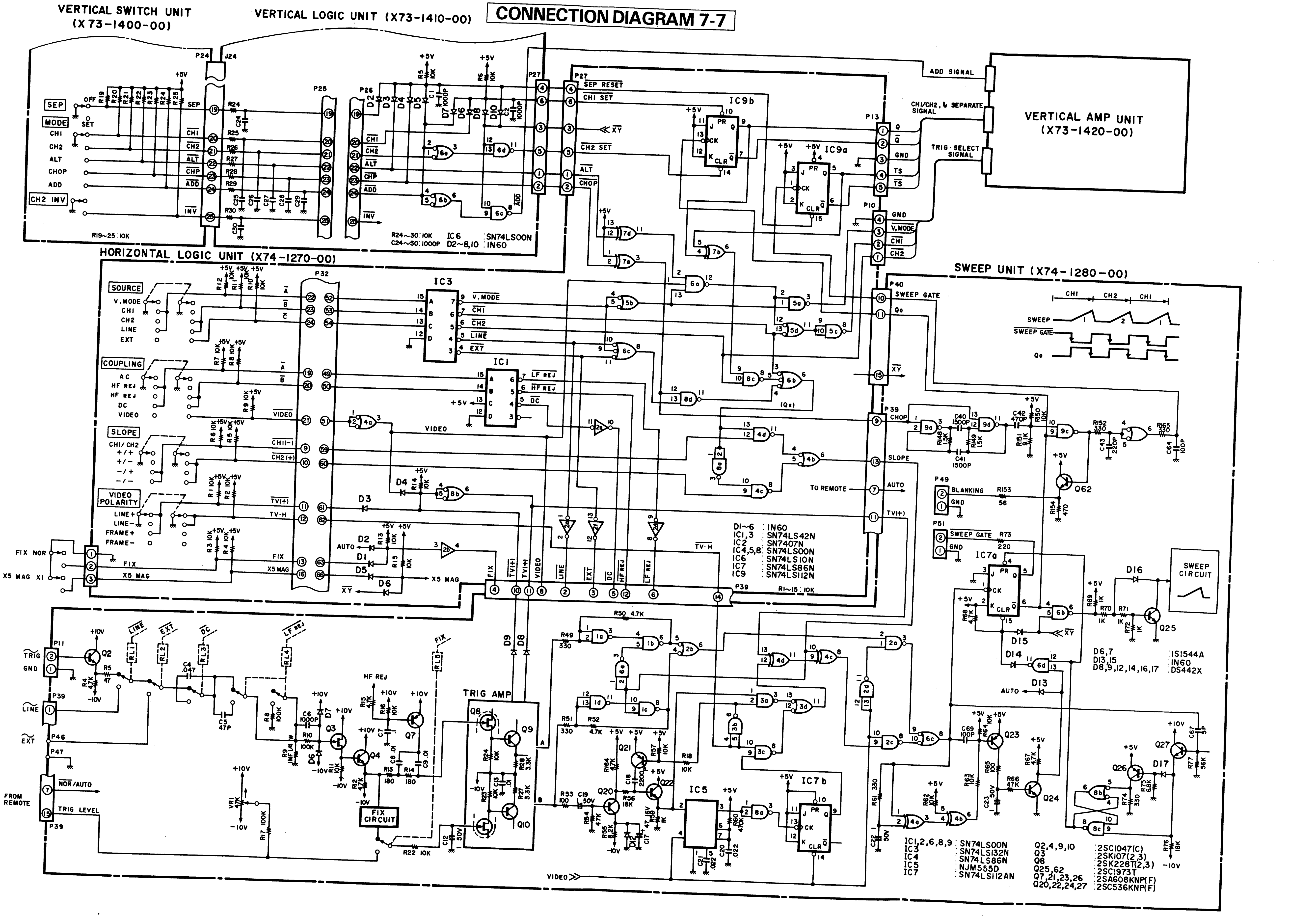

I/O UNIT (X81-1060-00)
HORIZONTAL SWITCH UNIT (X74-1260-00)
SWEEP VARIABLE PRESET
R15 10K
R14 10K
+5V
P38
SWP IB
SWP IA
1
2
3
CAL
S1
FI 57
FI 56
P32
F056
F057
7
8
73
74
SWP. 0A
SWP. 0B
SWP. PRE
SWP. VARI
SWP VAR2
15 14 13 12
A B C D
IC1
0 1 2 3
1 2 3 4
SWEEP TIME VARI. PRESET
+35V
R4 62K
R6 22K
R8 22K
R10 22K
VR4 10K
R1 15K
R5 27K
VR3 50K
VR2 50K
VR1 50K
D2
D3
D4
D5
D1
R7 27K
R9 27K
R11 27K
R3 4.7K
R2 4.7K
Q1
Q2
Q3
Q4
P45
19
20
CS-1720
P65
10
35
RT-1721
P13
REMOTE UNIT (X-77-1180-00)
P7
9
6
+5V
S7
SWEEP VARIABLE
VR15 50KB
CAL
R81 12KF
SWEEP UNIT (X74-1280-00)
P40
11
12
+35V
R90 56KF
Q34
Q35
C68 .01
R91 27K
HORIZONTAL LOGIC UNIT (X74-1270-00)

IC 1 : SN74LS42L
Q1~4 : 2SC536
D1~5 : DS442X

Q34 : 2SK30A (O)
Q35 : 2SA608K

# CIRCUIT DESCRIPTION

## CONNECTION DIAGRAM 7-7



VERTICAL SWITCH UNIT (X73-1400-00)
VERTICAL LOGIC UNIT (X73-1410-00)
VERTICAL AMP UNIT (X73-1420-00)
HORIZONTAL LOGIC UNIT (X74-1270-00)
SWEEP UNIT (X74-1280-00)
SEP
MODE
CH1
CH2
ALT
CHOP
ADD
CH2 INV
R19~25 :10K
R24~30 :10K
C24~30 :1000P
IC6 :SN74LS00N
D2~8,10 :1N60
ADD SIGNAL
CH1/CH2, & SEPARATE SIGNAL
TRIG·SELECT SIGNAL
IC9b
IC9a
SOURCE
V.MODE
LINE
EXT
COUPLING
AC
HF REJ
DC
VIDEO
SLOPE
CH1/CH2
VIDEO POLARITY
LINE+
LINE−
FRAME+
FRAME−
FIX NOR
X5 MAG X1
IC3
IC1
SWEEP GATE
SWEEP
Qo
BLANKING
SWEEP CIRCUIT
TO REMOTE
AUTO
TRIG AMP
FIX CIRCUIT
TRIG
GND
LINE
EXT
FROM REMOTE
NOR/AUTO
TRIG LEVEL
IC5
IC7a
IC7b
D1~6 :1N60
IC1,3 :SN74LS42N
IC2 :SN7407N
IC4,5,8 :SN74LS00N
IC6 :SN74LS10N
IC7 :SN74LS86N
IC9 :SN74LS112N
R1~15 :10K
D6,7 :1S1544A
D13,15 :1N60
D8,9,12,14,16,17 :DS442X
IC1,2,6,8,9 :SN74LS00N
IC3 :SN74LS132N
IC4 :SN74LS86N
IC5 :NJM555D
IC7 :SN74LS112AN
Q2,4,9,10 :2SC1047(C)
Q3 :2SK107(2,3)
Q8 :2SK228T(2,3)
Q25,62 :2SC1973T
Q7,21,23,26 :2SA608KNP(F)
Q20,22,24,27 :2SC536KNP(F)

# MAINTENANCE

## REMOVAL OF THE CASE

1. Remove the four phillips screws holding the cable wraps on the rear panel of the CS-1720, using a ⊕ screwdriver. Holding the front panel of the CS-1720, slide the case off backwards.
2. When replacing the unit in its case, slide it horizontally along the locating rails in the case base plate until the front panel is snug against the case.
3. Replace the cable wrap and screws, and tighten securely.

**CAUTION**

Potentially high voltage (6 kV) is applied to the CRT and anode cap. Before removing the case, ALWAYS switch off the power, and disconnect the power cable from the socket. If power is reconnected after removing the case BE EXTREMELY CAREFUL not to touch them with your hand or screwdriver.

## REMOVAL OR REPLACEMENT OF THE CRT

1. When removing the CRT for repair or maintenance, NEVER remove the CRT band. Remove only the mounting screws, and gently slide the CRT backwards, raise the socket up. If the above procedure is followed, removal of the CRT is easily accomplished. Replacement can be done easily.
2. Insert the CRT carefully. After locating the CRT on the retaining rubbers, tighten the CRT retaining screws loosely. Fix the screws of CRT bands so the CRT is in parallel with the frame and then tighten the screws of CRT mounting hardwave.
3. As slots are provided in the CRT bracket, the CRT can be moved right and left, and back and force. As the bracket is inclined by 45°, the CRT can be positioned in an arbitrary position. To fix the CRT, tighten the CRT retaining screws loosely and fix the CRT to be in parallel with the frame. Then, finally, fix the CRT retaining screws tightly.

**CAUTION:**

A high tension voltage is remained at the anode of the CRT. Before removing the CRT, connect the anode to the ground via a 100 kΩ load for 5 seconds to discharge the voltage.

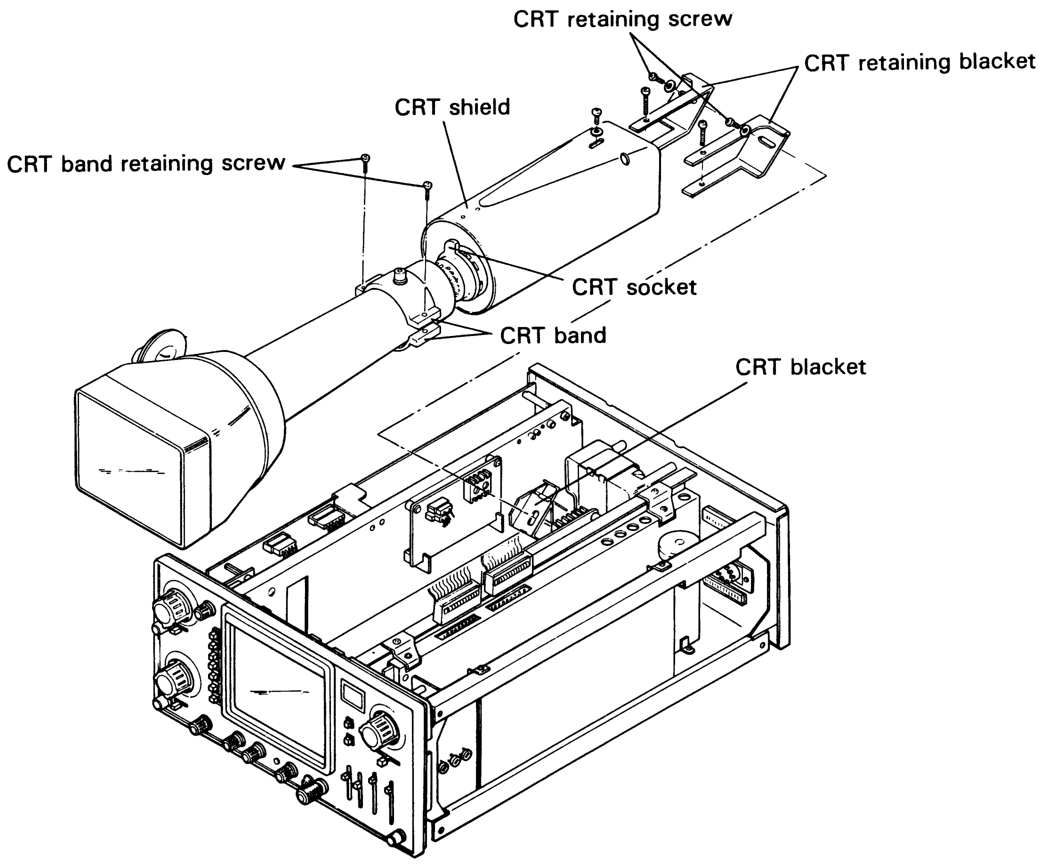


Fig. 8-1

# MAINTENANCE

## REPLACEMENT OF SWITCHING POWER SUPPLY

The switching power supply is in a shield case at the lower rear of the CS-1720. To remove the switching power supply, first remove the control and sweep units located on the right, and undo the screws holding the unit to the left/right frame.

## REMOVING CONTROL UNIT

First take off the two flat cables on the top of the unit, the three screws and the retaining hex. nut for the seven segment STEP LEDs, thereafter remove the connector on the side of the unit. To replace the control unit, follow the reverse procedure.

**NOTE**

The control unit has CMOS and RAM backup, therefore be sure to avoid handling it, or any of the connected components, roughly.

## REPLACING THE BATTERY

If the STEP LEDs flash on and off, it is an indication that the memory backup battery is low, and need replacing. In such a case, it must be changed in the control unit as soon as possible.

1. Remove the control unit from the body of the CS-1720 as previously described.
2. Remove the 8 screws on the shield case. The lithium battery is located on the right side of the P.C.B (X81-1050-00). If after checking the battery level it is less than 2 volts, replace with new battery, taking care to observe correct polarity, as shown on the component side of the printed circuit board.

**NOTE**

Note that if the backup battery of the Memory pack (MT-1725) is low, the STEP LEDs also flash, on and off.

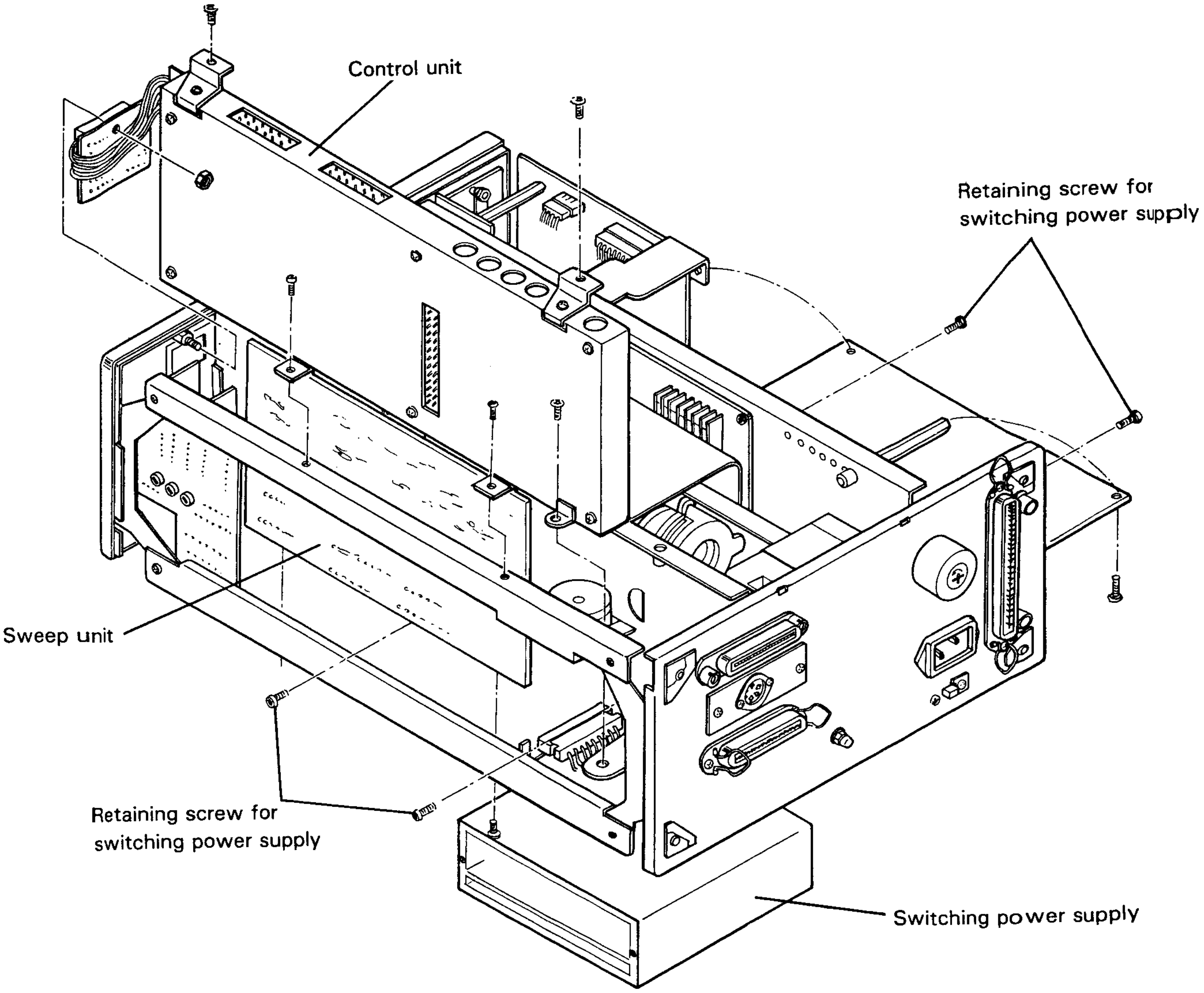

Control unit
Retaining screw for switching power supply
Sweep unit
Retaining screw for switching power supply
Switching power supply

Fig. 8-2

# ADJUSTMENT

To obtain the best performance, periodically accurately calibrate the unit.
Sometimes, only one mode need be calibrated, while at other times, all modes should be calibrated.
When one mode is calibrated, it must be noted that the other modes may be affected. When calibrating all modes, perform the calibration in the specified sequence.
The following calibration required an accurate measuring instrument and an insulated adjusting flat blade screwdriver. If they are not available, contact your dealer.
For optimum adjustment, turn the power on and warm up the CS-1720 sufficiently (more than 30 minutes) before starting.

**CAUTION:**
Calibrate the unit under the following condition.
Temperature: 10 – 35°C
Humidity: Less than 85%

## POWER SUPPLY VOLTAGE

Before calibrating the unit, check the power supply voltage.

Voltage selector: LOW; 90 – 132V
High; 180 – 264V
50/60 Hz

## TEST EQUIPMENT REQUIRED

The following instrument or their equivalent should be used for making adjustments.

| Test Equipment | Model | Minimum Specification |
|---|---|---|
| Digital Multi-Meter | DL-720 (TRIO) | Impedance: More than 10 MΩ,<br>Measuring range:<br>0.01V to 199V |
| Sine-Wave Generator | SG-502 (Tektronix) | Frequency: 10 Hz to 10 MHz, constant voltage over tuning range |
| Sine-Wave Generator | SG-503 (Tektronix) | Frequency: 50 kHz to 100 MHz,<br>Output impedance: 50Ω,<br>constant voltage over tuning range |
| Square-Wave Generator | PG-506 (Tektronix) | Output signal: 1 kHz,<br>Amplitude: 10 mVp-p to 10 Vp-p,<br>Accuracy: within ±1%,<br>Rise time: 35μs or less<br>(1 MHz, 1μs or less) |
| Q Meter | 4343B (YHP) | – |
| Color Pattern Generator | CG-911 (TRIO) | – |
| Oscilloscope | 475A (Tektronix) | Sensitivity: More than 5 mV<br>Frequency response: More than 250 MHz |
| Time-Marker Generator | TG-501 (Tektronix) | Time mark: 0.5s to 0.1μs repetitive waveform,<br>Accuracy: within 0.1% |
| High-Voltage Probe | – | Input Impedance: 1000 MΩ |
| Termination | TA-57 (TRIO) | Impedance: 50 Ω |
| Attenuator | 011-0059-02 | –20 dB attenuation (50Ω) |
| Power Meter | 2041 (YEW) | – |
| Auto transformer (variable) | SD-265 (Tektronix) | – |
| Power Supply | PR-657 (TRIO) | Output voltage: 0 to 32 V<br>Resolution: 1 mV |
| Digital Multimeter | 8600A FLUKE | 4-1/2 digit<br>Resolution: 100 μV |
| Frequency Counter | FC-754A (TRIO) | – |

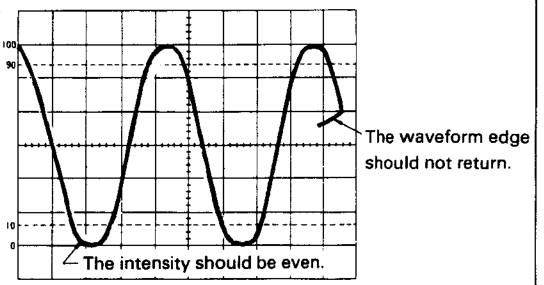
## PREPARATION FOR ADJUSTMENT

### Control Setting

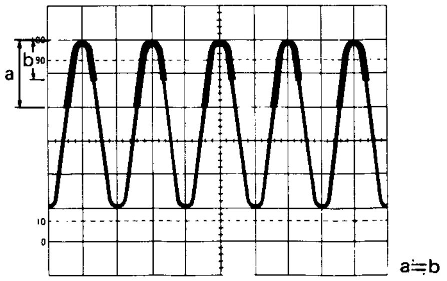
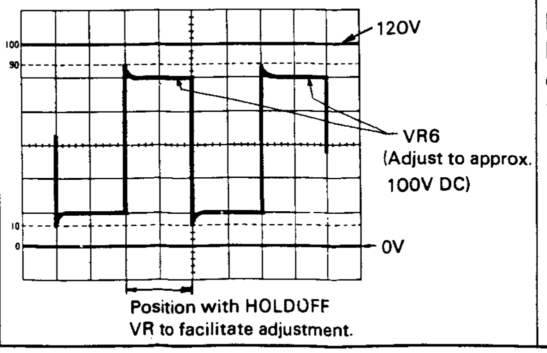
The control settings listed below must be used for each adjustment procedure. Exceptions to these settings will be noted as they occur. After completing a adjustment, return the controls to the following settings.

| | |
|---|---|
| **Power Section** | |
| POWER | ON |
| **CRT Control Section** | |
| INTENSITY | Between 12 and 3 o'clock |
| FOCUS | Optimum position |
| **Vertical Section** | |
| AC-GND-DC (CH1 and CH2) | AC |
| VOLTS/DIV (CH1 and CH2) | 5V/div |
| GAIN PRESET (CH1 and CH2) | CAL |
| MODE | CH1 |
| SEP | OFF (■) |
| CH2 INV | OFF (■) |
| **Horizontal Sweep Section** | |
| SWEEP TIME/DIV | 0.5ms/div |
| SWEEP TIME VARI PRESET | CAL |
| PUSH×5 MAG | ×1 (■) |
| **TRIG. Section** | |
| SOURCE | VERT MODE |
| COUPLING | AC |
| FIX/MANUAL | MANUAL (■) |
| SLOPE CH1/CH2 | +/+ |
| VIDEO POLARITY | LINE; + |
| **REMOTE Section (RT-1721)** | |
| GAIN PUSH PRESET (CH1 and CH2) | PUSH, CAL |
| ▲▼ POSITION PRESET (CH1 and CH2) | 3 (trace centered |
| ▲▼ POSITION (CH1 and CH2) | PUSH, 12 o'clock position |
| ◄► POSITION | 12 o'clock position |
| SWEEP TIME VARI PRESET | PUSH, CAL |
| TRIG. LEVEL | PUSH, 12 o'clock position |

# ADJUSTMENT

<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B. No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr><td colspan="8">ADJUSTMENT OF POWER SUPPLY AND CRT</td></tr>
<tr><td>Checking of Power Supply Voltage</td><td></td><td></td><td>DL-720</td><td></td><td>Measure and checking of voltage at P43 and P28<br><table><tr><th></th><th>1P</th><th>2P</th><th>3P</th><th>4P</th><th>5P</th><th>6P</th><th>7P</th><th>8P</th></tr><tr><td>P28</td><td>+55V</td><td>+20V</td><td>GND</td><td>+5V</td><td>+5V</td><td>+10V</td><td>−10V</td><td></td></tr><tr><td>P43</td><td>+120V</td><td>+55V</td><td>+20V</td><td>GND</td><td>+5V</td><td>+5V</td><td>+10V</td><td>−10V</td></tr></table></td><td></td><td></td></tr>
<tr><td>Adjustment of −1.5kV</td><td>VR3</td><td>X68-1350</td><td>DL-720<br>High voltage probe</td><td></td><td>Measure the voltage on P60, 2P and adjust VR3 to obtain −1.5kV (1.500-1.505kV)</td><td></td><td></td></tr>
<tr><td>Coarse Adjustment of ASTIG and FOCUS</td><td>VR5</td><td>X68-1350</td><td></td><td>SWEEP TIME/DIV: X-Y<br>CH1, CH2, AC-GND-DC: GND<br>CH1, CH2, ⬍ POSITION: Pulled out</td><td>1. Operate ⬍ POSITION for CH1 and CH2 to position the sopt in the center of the CRT screen.<br>2. Adjust VR5 to make the spot round and smaller with locating FOCUS knob on the center.</td><td></td><td></td></tr>
<tr><td>Adjustment of INTENSITY</td><td>VR1</td><td>X68-1350</td><td></td><td>SWEEP TIME/DIV: X-Y<br>CH1, CH2, AC-GND-DC: GND<br>CH1, CH2, ⬍ POSITION: Pulled out</td><td>Adjust VR1 so that the spot on the CRT screen disappears when INTENSITY is set in the position of 9:30-10:00</td><td></td><td></td></tr>
<tr><td>Adjustment of Blanking</td><td>TC2</td><td>X68-1350</td><td>SG-503</td><td>SWEEP TIME/DIV: 0.2μs<br>CH1, AC-GND-DC: DC<br>CH1, VOLTS/DIV: 1V<br>INTENSITY: Fully CW</td><td>1. Apply a 1MHz sine wave signal to CH1 input and operate ⬍ POSITION and CH1 VOLTS/DIV to display a waveform of 6 divisions vertical amplitude.<br>2. Adjust TC2 so that the start point of waveform has even brightness and there is no retrace.</td><td>

100<br>90<br>10<br>0<br>The waveform edge should not return.<br>The intensity should be even.

</td><td></td></tr>
<tr><td>Adjustment of Z-Axis Input Blanking</td><td>TC1</td><td>X68-1350</td><td>SG-503</td><td>SWEEP TIME/DIV: 5μs<br>CH1, AC-GND-DC: DC<br>CH1, VOLTS/DIV: 1V</td><td>1. Apply a 100 kHz, 5Vp-p sine wave signal to CH1 input to display a waveform of 5 divisions vertical amplitude.<br>2. Apply the same signal above to Z-axis input and turn INTENSITY to CCW so that the dark and bright area of the waveform are distinct.<br>3. Adjust TC1 so that the bright area of sine waveform is symmetrical to the peak point.</td><td> </td><td></td></tr>
<tr><td>Adjustment of Auto FOCUS Level</td><td>VR2</td><td>X68-1350</td><td>475A<br>Probe (1/10)</td><td>INTENSITY: Fully CW<br>SWEEP TIME/DIV: 20μs</td><td>1. Set the oscilloscope (475A) for the vertical axis sensitivity at 2V/div.<br>2. Observe the waveform of the auto focus display point on the AUTO FOCUS circuit (collector of Q10), and adjust VR2 so that the upper DC level of the square waveform is approx. 100V (more than 95V).</td><td>

120V<br>100<br>90<br>10<br>0<br>VR6<br>(Adjust to approx. 100V DC)<br>0V<br>Position with HOLDOFF VR to facilitate adjustment.

</td><td>Be sure that the AC-GND-DC selector switch of the oscilloscope (475A) is at "DC" position.</td></tr>
</table>

# ADJUSTMENT

| Item | Adjustment Control | P.C.B. No. | Test Equipment | Control Setting | Adjustment and Check | Illustration | Remark |
|---|---|---|---|---|---|---|---|
| **Adjustment of Auto FOCUS waveform Forming** | TC3 | X68-1350 | 475A<br>Probe (1/10) | INTENSITY: Fully CW<br>CH1 AC-GND-DC: GND | Vary SWEEP TIME/DIV from 0.1 ms to 0.2 μs and adjust TC3 so that the start of trace become an ideal waveform. | | |
| **Adjustment of CRT Center** | VR2 | X73-1430 | | TRIG LEVEL: Pushed in | Short-circuit the test point (TP1) of X73-1420 and adjust VR2 so that the trace aligns with the horizontal center graticule line. | | |
| **Adjustment of Vertical Geometry** | VR1 | X73-1430 | DL-720 | | Short the short-circuit the test point (TP1) of the X73-1420 and adjust VR1 for 28V±0.5V reading on the voltmeter. | | |
| **Adjustment of ASTIG and FOCUS** | VR5 | X68-1350 | | SWEEP TIME/DIV: X-Y<br>CH1, CH2, AC-GND-DC: GND | 1. Operate ⬍ POSITION for CH1 and CH2 so that the spot is brought into the center of the screen.<br>2. Adjust VR5 to make the spot round and smaller.<br>(Check)<br>1. Make sure that the spot grows larger when the FOCUS is turned CW or CCW.<br>2. Make sure that the FOCUS is in a centered position when the spot is smallest. | | Be sure to bring the spot into the center of the screen.<br>It may be difficult to obtain the correct adjusting position near the edge of the screen due to the CRT peripheral blur. |
| **Adjustment of Trace Rotation** | Trace rotation knob | | | MODE: CH1<br>TRIG LEVEL: AUTO<br>CH1, AC-GND-DC: GND | 1. Operate ⬍ POSITION for CH1 to move the trace to the center of the screen.<br>2. Make adjustment to align the trace with the horizontal center graticule line. | | |
| **ADJUSTMENT OF VERTICAL AXIS** | | | | | | | |
| **Adjustment of CH1 ATT BAL** | VR11 | X75-1120 | | MODE: CH1<br>CH1, AC-GND-DC: DC<br>TRIG LEVEL: AUTO | Adjust VR11 for minimum or zero movement to CH1 10mV reference line when set CH1 VOLTS/DIV to 2mV.<br>(Check)<br>Movement of trace in all ranges should be within ±0.1 div. | | |
| **Adjustment of CH2 ATT BAL** | VR12 | X75-1130 | | MODE: CH2<br>TRIG LEVEL: AUTO<br>CH2, AC-GND-DC: DC | Adjustment is carried out as for CH1 ATT adjustment above. | | |
| **Adjustment of CH1 DC BAL** | VR1 | X73-1420 | | CH1, AC-GND-DC: GND<br>CH1, VOLTS/DIV: 2mV<br>CH1, GAIN: Pulled out | 1. Turn CH1 GAIN to fully CCW.<br>2. Operate ⬍ POSITION so that the trace aligns with the horizontal center graticule line on the screen.<br>3. Pull CH1 GAIN and turn to fully CW (CAL).<br>If the trace moves vertically, adjust VR1 for minimum or zero movement.<br>4. Repeat above procedures.<br>(Check)<br>Movement of trace: within 0.2 div. | | |
| **Adjustment of CH2 DC BAL** | VR4 | X73-1420 | | CH2, AC-GND-DC: GND<br>CH2, VOLTS/DIV: 2mV<br>CH2, GAIN: Pulled out | Adjustment is carried out as for CH1 DC BAL adjustment above. | | |
| **Adjustment of CH1 GAIN VARI** | VR5 | X75-1130 | PG-506<br>BNC-BNC cord | MODE: CH1<br>TRIG LEVEL: AUTO<br>CH1, AC-GND-DC: DC<br>CH1, VOLTS/DIV: 2mV<br>CH1, GAIN: Pulled out, CAL | 1. Apply a 1kHz, 10mVp-p square wave signal to CH1 input.<br>2. Operate CH1 ⬍ POSITION to produce a waveform on the center of the screen.<br>3. Adjust VR5 to become the waveform smaller in 12 o'clock position by pulling the CH1 GAIN and turning CCW. | | |
| **Adjustment of CH2 GAIN VARI** | VR10 | X75-1130 | | MODE: CH2<br>TRIG LEVEL: AUTO<br>CH2, AC-GND-DC: DC<br>CH2, VOLTS/DIV: 2mV<br>CH2, GAIN: Pulled out, CAL | Adjustment is carried out as for CH1 GAIN VARI adjustment above. | | |

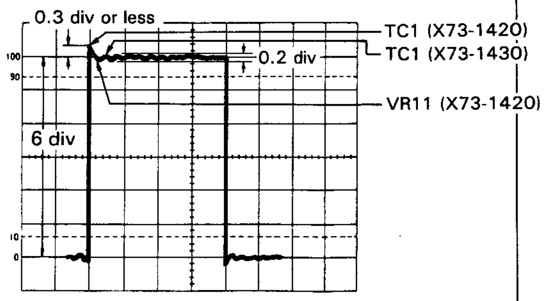
# ADJUSTMENT

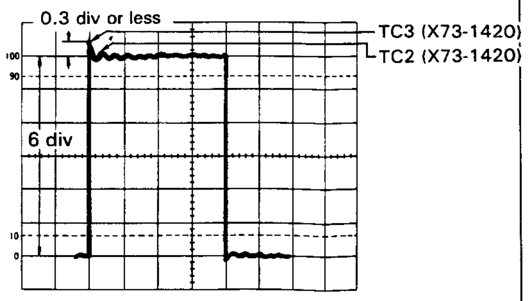
<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B. No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr><td><b>Adjustment of CH1 GAIN</b></td><td>VR3</td><td>X74-1420</td><td>PG-506<br>BNC-BNC cord</td><td>MODE: CH1<br>CH1, AC-GND-DC: DC<br>CH1, VOLTS/DIV: 2mV<br>CH1, GAIN: Pulled out, CAL</td><td>1. Apply a 10mVp-p, 1kHz square wave signal to CH1 input.<br>2. Operate CH1 ↕ POSITION to display a waveform on the center of the screen.<br>3. Adjust VR3 so that the amplitude of waveform becomes 5 divisions.<br>(Check)<br>Turn CH1 VOLTS/DIV and apply a reference signal to display a 4 to 6 div amplitude waveform when the MODE CH1 and CH1 SEP pushbuttons are depressed respectively in all ranges.<br>Sensitivity error: within ±5%</td><td></td><td>(Reference)<br>Method of calculation of sensitivity error.<br>Sensitivity error<br>$=\frac{a-b}{b}\times 100\%$<br>a = CRT screen amplitude<br>b = Input signal voltage/VOLTS/DIV settings</td></tr>
<tr><td><b>Adjustment of CH2 GAIN</b></td><td>VR9</td><td>X73-1420</td><td>PG-506<br>BNC-BNC cord</td><td>MODE: CH2<br>CH2, AC-GND-DC: DC<br>CH2, VOLTS/DIV: 2mV<br>CH2, GAIN: Pushed in, CAL</td><td>1. With MODE CH2, apply a 10mVp-p, 1kHz square wave signal to CH2 input.<br>2. Adjustment is carried out as for CH1 GAIN adjustment above.<br>(Check)<br>1. Turn CH2 VOLTS/DIV and apply a reference signal to display a 4 to 6 div vertical amplitude waveform when the MODE CH2 and CH2 SEP pushbuttons are depressed respectively in all ranges.<br>Check that the sensitivity error is within ±5%.<br>2. Apply a 10mVp-p, 1kHz square wave signal to both CH1 and CH2 inputs. Depress ADD and CH2 INV of MODE and select SOURCE switch to CH1. By using both CH1 and CH2 ↕ POSITION, two traces should align on the center of the screen.<br>Channel error between CH1 and CH2: 0.1 div at 1kHz.</td><td></td><td></td></tr>
<tr><td><b>Checking of CH1 and CH2 GAIN VARI</b></td><td></td><td></td><td>PG-506<br>BNC-BNC cord</td><td>CH1, CH2, AC-GND-DC: DC<br>CH1, CH2, VOLTS/DIV: 2mV<br>CH1, CH2, GAIN: Pulled out, CAL</td><td>1. With MODE CH1, apply a 10mVp-p, 1kHz square wave signal to CH1 input.<br>2. When the GAIN control is turned to fully CCW, the sensitivity should be within 1/2.5 in comparison with CAL position.<br>3. Select MODE to CH2, and carry out the same procedure as for CH1 above.</td><td></td><td></td></tr>
<tr><td><b>Checking of CH1 GAIN PRESET and Setting</b></td><td>VR1<br>VR2<br>VR3<br>VR4</td><td>X75-1130</td><td>PG-506</td><td>MODE: CH1<br>CH1, AC-GND-DC: DC<br>CH1, VOLTS/DIV: 2mV<br>CH1, GAIN: Pushed in, CAL</td><td>1. Apply a 10mVp-p, 1kHz square wave signal to CH1 input.<br>2. Set GAIN PRESET to position (1) and adjust VR1 so that its sensitivity becomes less than 1/2.5 when rotated GAIN PRESET adjustment control (1) on the left side panel to CCW.<br>3. Adjust VR2 to VR4 in the same procedure for step (1) and (2).<br>4. After checking the above procedure, adjust CH1 GAIN PRESET VR as in the table below.
<table>
<tr><td>GAIN PRESET</td><td>1</td><td>2</td><td>3</td><td>4</td><td>CAL</td></tr>
<tr><td>Setting (div)</td><td>MIN</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
</table></td><td></td><td></td></tr>
<tr><td><b>Checking of CH2 GAIN PRESET and Setting</b></td><td>VR6<br>VR7<br>VR8<br>VR9</td><td>X75-1130</td><td>PG-506</td><td>MODE: CH2<br>CH2, AC-GND-DC; DC<br>CH2, VOLTS/DIV: 2mV<br>CH2, GAIN: Pushed in, CAL</td><td>Carry out the same procedure as for CH1 above.</td><td></td><td></td></tr>
</table>

# ADJUSTMENT

<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B. No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr><td><b>Adjustment of CH1 ⇕ POSITION</b></td><td>VR2</td><td>X73-1420</td><td></td><td>MODE: CH1<br>CH1, AC-GND-DC: GND<br>CH1, ⇕ POSITION: Pushed in, center<br>CH1, POSITION PRESET: 3, mechanical center</td><td>1. Adjust VR2 so that the trace aligns with the horizontal center graticule line on the screen.<br>(Check)<br>1. When CH1 POSITION PRESET through 1 to 5 is turned to fully CW, the trace must move upward more than 4 divisions and it must move downward more than 4 divisions when turned to fully CCW.<br>2. When CH1 ⇕ POSITION is pulled out and turned to CW and CCW, the trace should move at least ±2 div from POSITION PRESET settings.<br>3. By adjusting VR for 1 to 5, CH1 POSITION PRESET settings should be as in the table below.
<table>
<tr><td>POSITION PRESET</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Trace position (div)</td><td>+4</td><td>+2</td><td>center</td><td>−2</td><td>−4</td></tr>
</table></td><td></td><td></td></tr>
<tr><td><b>Adjustment of CH2 ⇕ POSITION</b></td><td>VR5</td><td>X73-1420</td><td></td><td>MODE: CH2<br>CH2, AC-GND-DC: GND<br>CH2, ⇕ POSITION: Pushed in, center<br>CH2, POSITION PRESET: 3, mechanical center</td><td>For CH2 adjustment and checking, carry out same procedure as for CH1 above.</td><td></td><td></td></tr>
<tr><td><b>Adjustment of CH2 INV Position</b></td><td>VR6</td><td>X73-1420</td><td></td><td>CH2, AC-GND-DC: GND<br>CH2, VOLTS/DIV: 2mV<br>CH2, INV: Pushed in</td><td>Adjust VR6 to bring the trace to its position at CH2 NORM.<br>(Check)<br>1. Vertical deviation between CH2 NORM and INV: within 1div<br>2. The trace should move more than 4 divisions upward when turned CH2 ⇕ POSITION fully CW and it should move more than 4 divisions downward when turned fully CCW.</td><td></td><td></td></tr>
<tr><td><b>Checking of trace movement in DISPLAY MODE</b></td><td></td><td></td><td></td><td>CH1, CH2, AC-GND-DC: GND<br>CH1, CH2, VOLTS/DIV: 2mV</td><td>1. When changing the MODE switch from CH1 to CH2, ALT, CHOP or ADD, the trace movement should be within 0.2div.</td><td></td><td></td></tr>
<tr><td><b>Checking of SEPARATE PRESET and Setting</b></td><td>VR13</td><td>X75-1130</td><td>PG-506</td><td>CH1, CH2, AC-GND-DC: DC<br>CH1, CH2, VOLTS/DIV: 5mV<br>CH1, CH2, ⇕ POSITION: center (main sweep)</td><td>1. Depress both CH1 and SEP pushbuttons of MODE or both CH2 and SEP pushbuttons. When turned SEPARATE PRESET (VR13) to CW on the left side panel, the SEP trace should move more than 4 divisions upward from main trace and when turned to CCW, it should move more than 4 divisions downward.<br>2. Set the SEP trace to −3div position to main trace using VR13.<br>3. Check the SEP trace moves together if turned CH1 or CH2 ⇕ POSITION.<br>4. Select MODE to CH1 and apply a 10mV, 1kHz square wave signal to CH1 input. Check that in SLOPE CH1 side +/−, MAIN sweep, and in SLOPE CH2 side +/−, SUB sweep are both displayed.<br>5. When selected MODE to CH2 if applied the same signal to CH2 input, the MAIN and SUB sweeps are reversed.</td><td></td><td></td></tr>
<tr><td><b>Checking of Trace Movement in AC-GND-DC</b></td><td></td><td></td><td></td><td></td><td>In both CH1 and CH2 position, by using AC-GND-DC switch, trace movement should not vary beyond 0.1 div.</td><td></td><td></td></tr>
</table>

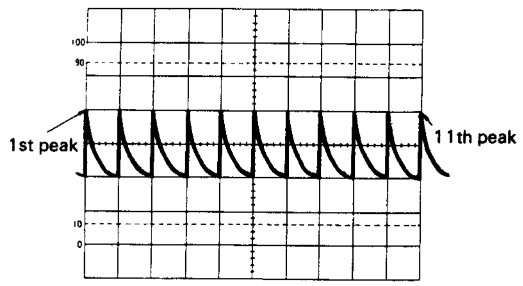
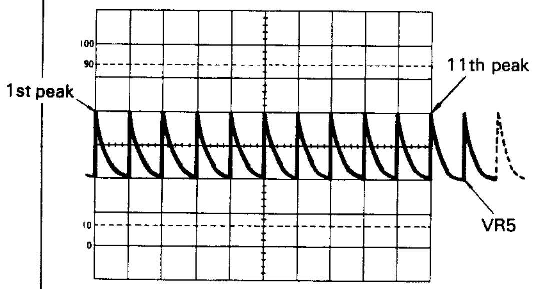
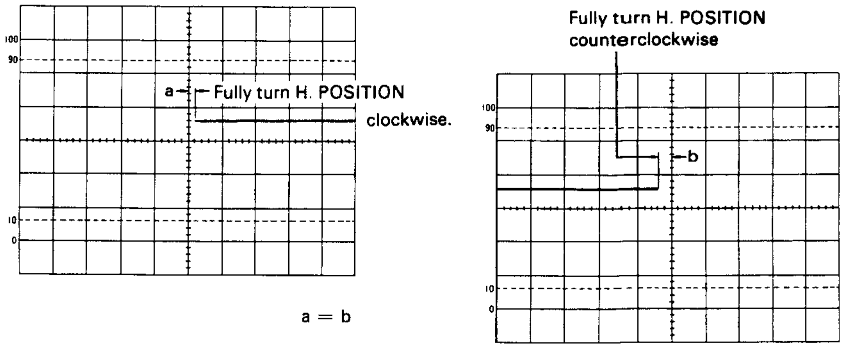
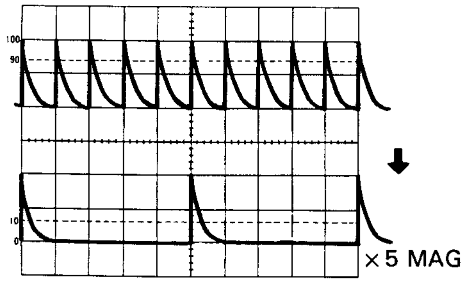
# ADJUSTMENT

<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B. No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr><td>Adjustment of CH1 ATT and CH2 ATT</td><td></td><td>X75-1130</td><td>434B<br>PG-506</td><td>CH1, CH2, AC-GND-DC: DC</td><td>1. Shaping of waveform<br>Apply a 1kHz square wave signal to CH1 and CH2 inputs and adjust the oscillator output to display a waveform of 5 to 6 divisions vertical amplitude.<br>Make adjustment so that the waveform quality of each range is equal to that of the 2mV range.<br>2. Input capacitance<br>Connect a Q-meter to CH1 and CH2 inputs and make adjustment so that the input capacitance of each range is equal to that to the 2mV range. (37±3pF)
<table>
<tr><th colspan="2">Sequence</th><th>Adjustment</th><th>Adj control</th></tr>
<tr><td rowspan="4">CH1</td><td>1</td><td>20 mV range Waveform shaping</td><td>TC4</td></tr>
<tr><td>2</td><td>20 mV range Input capacity</td><td>TC3</td></tr>
<tr><td>3</td><td>0.2 V range Waveform shaping</td><td>TC2</td></tr>
<tr><td>4</td><td>0.2 V range Input capacity</td><td>TC1</td></tr>
<tr><td rowspan="4">CH2</td><td>1</td><td>20 mV range Waveform shaping</td><td>TC8</td></tr>
<tr><td>2</td><td>20 mV range Input capacity</td><td>TC7</td></tr>
<tr><td>3</td><td>0.2 V range Waveform shaping</td><td>TC6</td></tr>
<tr><td>4</td><td>0.2 V range Input capacity</td><td>TC5</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>Adjustment of CH1 Square Wave Characteristics</td><td>TC1<br>VR11<br>TC1</td><td>X73-1430<br>X73-1420<br>X73-1420</td><td>PG-506</td><td>CH1, AC-GND-DC: DC<br>CH1, VOLTS/DIV: 2mV</td><td>1. Apply a 100kHz short rise time square wave signal to CH1 input and adjust the oscillator output to display a waveform of 6 divisions vertical amplitude.<br>2. The waveform is shaped by carrying out adjustment in following order.<br>TC1..........low range adjustment<br>VR11........mid and high ranges adjustment<br>TC1..........high range adjustment</td><td>
0.3 div or less<br>0.2 div<br>6 div<br>100<br>90<br>10<br>0<br>TC1 (X73-1420)<br>TC1 (X73-1430)<br>VR11 (X73-1420)

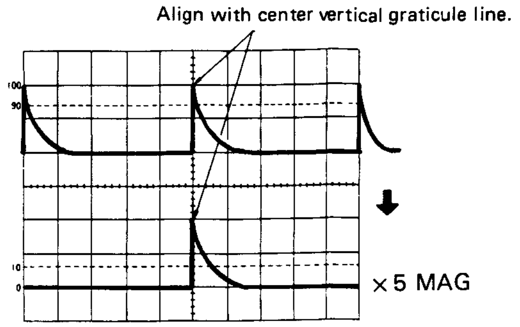
</td><td></td></tr>
<tr><td>Adjustment of CH2 Square Waveform Characteristics</td><td>TC2<br>TC3</td><td>X73-1420<br>X73-1420</td><td>PG-506</td><td>MODE: CH2<br>CH2, AC-GND-DC: DC<br>CH2, VOLTS/DIV: 2mV</td><td>1. Apply the above same signal to CH2 input and adjust in the same way as for CH1 above.<br>TC2..........mid range adjustment<br>TC3..........high range adjustment<br>(Check)<br>1. Overshoot :less than 5%<br>2. Undershoot :less than 3.5%<br>3. Carry out adjustment for all range.</td><td>
0.3 div or less<br>6 div<br>100<br>90<br>10<br>0<br>TC3 (X73-1420)<br>TC2 (X73-1420)

</td><td></td></tr>
<tr><td>Checking of CH1 and CH2 Frequency Characteristics</td><td></td><td></td><td>SG-503<br>50Ω coaxial cable<br>50Ω, 20dB attenuator</td><td>CH1, CH2, AC-GND-DC: DC</td><td>1. Turn CH1 VOLTS/DIV to 2mV and apply a 50kHz sine wave signal to CH1 input.<br>Adjust the oscillator output to display a waveform of 6 divisions vertical amplitude.<br>2. When the frequency is varied to 20MHz with the oscillator output remaining output, the amplitude on the screen must be over 4.25 divisions and there must be no sudden dips and peaks during attenuation.<br>3. Carry out the same way for CH2.</td><td></td><td></td></tr>
</table>

# ADJUSTMENT

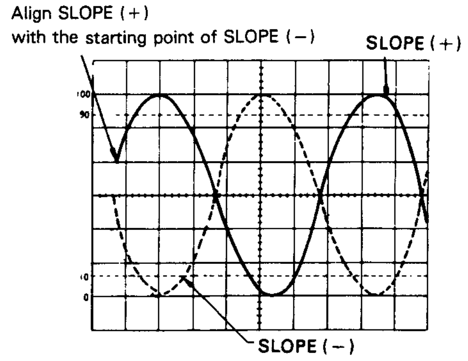
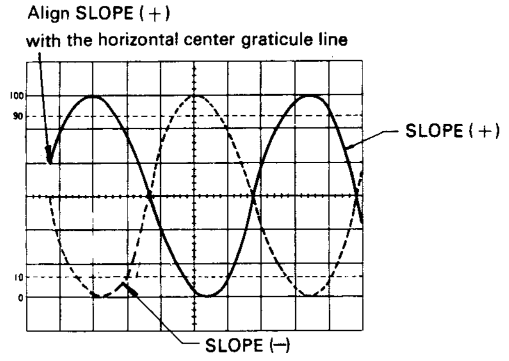
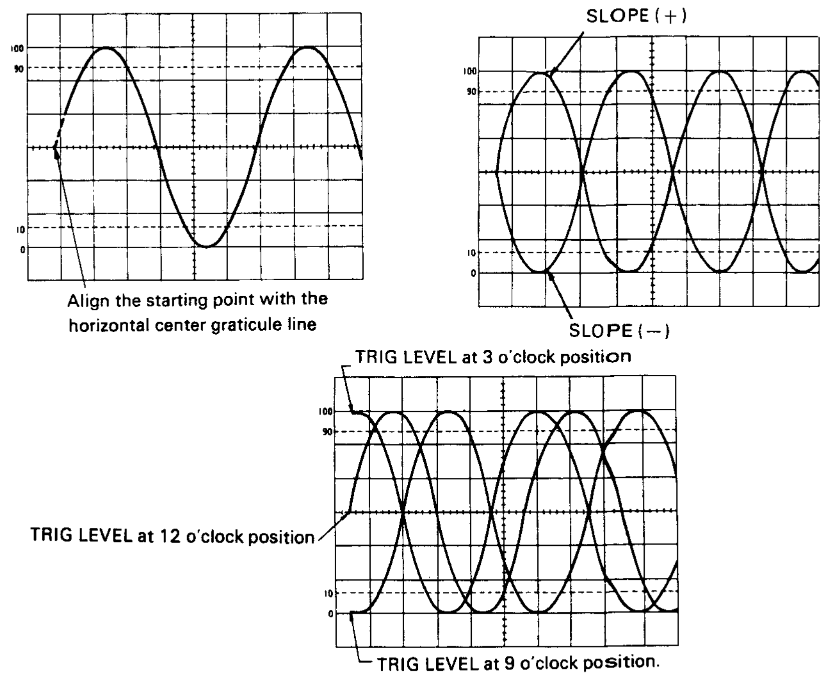
| Item | Adjustment Control | P.C.B. No. | Test Equipment | Control Setting | Adjustment and Check | Illustration | Remark |
|---|---|---|---|---|---|---|---|
| **ADJUSTMENT OF HORIZONTAL SWEEP** | | | | | | | |
| **Adjustment of Sweep Time** | VR4 | X74-1280 | TG-501 | CH1, AC-GND-DC: AC<br>CH1, VOLTS/DIV: 0.5V<br>SWEEP TIME/DIV: 1ms<br>SWEEP TIME VARI PRESET: CAL<br>SWEEP TIME VARI: Pushed in, CAL | 1. Apply a 0.1ms marker signal to CH1 input.<br>2. Operate ◄► POSITION to bring the first peak of the marker signal to left end of the graticule line and adjust VR4 for the 11th peak to the right end of the graticule line. |  | |
| **Adjustment of SWEEP TIME VARI** | VR4 | X74-1260 | TG-501 | CH1, AC-GND-DC: AC<br>CH1, VOLTS/DIV: 0.5V<br>SWEEP TIME/DIV: 1ms<br>SWEEP TIME VARI PRESET: CAL<br>SWEEP TIME VARI: Pushed in, CAL | 1. After carrying out the above adjustment, set SWEEP TIME VARI control to pulled out; CAL.<br>2. Adjust as for pushed in above. | | |
| **Adjustment of Sweep Length** | VR5 | X74-1280 | TG-501 | CH1, AC-GND-DC: AC<br>CH1, VOLTS/DIV: 0.5V<br>SWEEP TIME/DIV: 1ms<br>SWEEP TIME VARI PRESET: CAL<br>SWEEP TIME VARI: Pushed in, CAL | 1. Apply a 1ms marker signal to CH1 input.<br>2. Adjust VR5 to display 11 peaks.<br>(Check)<br>Specification on all ranges: 10.5-13 div. |  | (Note)<br>The waveform moves 2 div leftward and by turning ◄► POSITION to CCW and is able to observe 11th peak at the right end of the graticule line. |
| **Adjustment of Sweep Position** | VR6 | X74-1280 | | TRIG LEVEL: Pushed in | 1. Set CH1 AC-GND-DC to GND to bring the trace to the center of the CRT screen.<br>2. Turn ◄► POSITION to fully CW and measure the deviation between the start point of the trace and the center of the screen.<br>3. Turn ◄► POSITION to fully CCW and measure the deviation between the ending point of the trace and the center of the screen.<br>Make adjustment so that these deviations will have the same width.<br>Width error: within ±0.5 div |   a<br>Fully turn H. POSITION clockwise.<br>a = b<br>Fully turn H. POSITION counterclockwise<br>b | |
| **Adjustment of ×5 MAG Gain** | VR1 | X74-1290 | TG-501 | CH1, AC-GND-DC: AC<br>CH1, VOLTS/DIV: 0.5V<br>SWEEP TIME/DIV: 1ms<br>SWEEP TIME VARI: CAL | 1. Apply a 1ms marker signal to CH1 input to display a waveform of about 2 divisions vertical amplitude.<br>2. Align the first peak of the marker signal with the left end of the graticule line and 11th peak with the right end and depress ×5 MAG knob.<br>3. Adjust VR1 so that the peak-to-peak distance is 5 divisions.<br>(Check)<br>Specification on all ranges: 5 times within ±5% |  | |

# ADJUSTMENT

<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B. No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr><td><b>Adjustment of ×5 MAG Center</b></td><td>VR2</td><td>X74-1290</td><td>TG-501</td><td>SWEEP TIME/DIV: 1ms<br>CH1, AC-GND-DC: AC<br>CH1, VOLTS/DIV: 0.5V<br>SWEEP TIME VARI: CAL</td><td>1. Apply a 5ms marker signal to CH1 input to display 3 peaks waveform.<br>2. Operate ◄► POSITION to bring the central peak to the vertical center graticule line.<br>3. Adjust VR2 so that the waveform will be aligned with vertical center graticule line when the × 5 MAG knob is depressed.<br>(Check)<br>When depressed and released alternately, check that the center of the waveform does not move.<br>Center deviation of × 5 MAG: within ± 1 div</td><td>
Align with center vertical graticule line.<br>100<br>90<br>10<br>0<br>× 5 MAG

</td><td></td></tr>
<tr><td><b>Adjustment of Sweep Time, 0.2μs</b></td><td>TC1</td><td>X74-1290</td><td>TG-501</td><td></td><td>1. With SWEEP TIME/DIV set to 0.2μs, apply a 0.2μs marker signal to CH1 input.<br>2. Adjust TC1 so that the each peak corresponds to each vertical graticule line.</td><td></td><td></td></tr>
<tr><td><b>Checking of Sweep Time Error in All Ranges</b></td><td></td><td></td><td></td><td></td><td>1. Apply a reference time marker signal for each range of SWEEP TIME/DIV.<br>2. Measure the time error rate and make sure that it is within the specification limits.<br>Specification: within ± 5%</td><td></td><td></td></tr>
<tr><td><b>Checking of SWEEP TIME VARI</b></td><td></td><td></td><td>TG-501</td><td>SWEEP TIME VARI PRESET: CAL<br>SWEEP TIME VARI: Pushed in, CAL</td><td>1. Apply a reference time marker signal for each range of SWEEP TIME/DIV and align each peak with the vertical graticule line.<br>2. When pulled out SWEEP TIME VARI and turned to fully CCW, sweep rate should be within 1/2.5 in comparison with CAL position.</td><td></td><td></td></tr>
<tr><td><b>Checking of SWEEP TIME VARI PRESET</b></td><td>VR1<br>VR2<br>VR3</td><td>X74-1260</td><td>TG-501</td><td>SWEEP TIME VARI PRESET: CAL<br>SWEEP TIME VARI: Pushed in, CAL</td><td>1. Apply a reference time marker signal for each range of SWEEP TIME/DIV and align each peak with the vertical graticule line.<br>2. Set SWEEP TIME PRESET to position (1) and adjust VR1 so that its sweep time rate becomes less than 1/2.5 when rotated SWEEP TIME PRESET adjustment control (1) on the right side panel to CCW.<br>3. Adjust VR2 and VR3 in the same procedure as the step for VR1.<br>4. After checking the above procedure, check that the value for PRESET (3), (2) and (1) are one division less in that order, as shown in the table below.
<table>
<tr><td>SWEEP TIME PRESET</td><td>1</td><td>2</td><td>3</td><td>CAL</td></tr>
<tr><td>Adj control</td><td>VR1</td><td>VR2</td><td>VR3</td><td>–</td></tr>
<tr><td>Setting (div)</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
</table></td><td></td><td></td></tr>
</table>

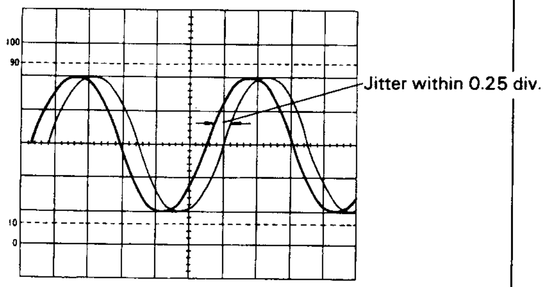
# ADJUSTMENT

| Item | Adjustment Control | P.C.B. No. | Test Equipment | Control Setting | Adjustment and Check | Illustration | Remark |
|---|---|---|---|---|---|---|---|
| **ADJUSTMENT OF TRIGGERING** | | | | | | | |
| **Adjustment of FIX Trig Slope** | VR3 | X74-1280 | SG-502 | CH1, AC-GND-DC: AC<br>CH1, VOLTS/DIV: 5mV<br>MODE: CH1<br>SWEEP TIME/DIV: 0.2ms<br>MANUAL/FIX: FIX (▂)<br>SOURCE: VERT MODE<br>COUPLING: AC<br>SLOPE: CH1 +<br>TRIG LEVEL: Pushed in, AUTO | 1. Apply a 1kHz sine wave signal to CH1 input and adjust the oscillator output to display a waveform of 4 to 6 divisions vertical amplitude.<br>2. Operate ↕ POSITION so that the waveform may have an amplitude equally above and below the horizontal center graticule line.<br>3. Adjust VR3 so that the start point of the waveform is the same for both when selected SLOPE CH1 (+) to (−) alternately. |  Align SLOPE (+)<br>with the starting point of SLOPE (−)<br>SLOPE (+)<br>100<br>90<br>10<br>0<br>SLOPE (−) | |
| **Adjustment of FIX Trig Center** | VR2 | X74-1280 | SG-502 | CH1, AC-GND-DC: AC<br>CH1, VOLTS/DIV: 5mV<br>MODE: CH1<br>SWEEP TIME/DIV: 0.2ms<br>MANUAL/FIX: FIX (▂)<br>SOURCE: VERT MODE<br>COUPLING: AC<br>SLOPE: CH1 +<br>TRIG LEVEL: Pushed in, CAL | 1. After carrying out the above, adjust VR2 so that the start point of waveform is on the horizontal center graticule line.<br>2. Adjust the oscillator output to display a waveform of less than 1 division vertical amplitude.<br>Adjust VR2 (VR3) to obtain the stable synchronization when selected (+) to (−) alternately. |  Align SLOPE (+)<br>with the horizontal center graticule line<br>SLOPE (+)<br>100<br>90<br>10<br>0<br>SLOPE (−) | |
| **Adjustment of Trig Level (1)** | VR1 | X74-1280 | SG-502 | CH1, CH2, AC-GND-DC: AC<br>CH1, CH2, VOLTS/DIV: 5mV<br>SWEEP TIME/DIV: 0.2ms<br>MANUAL/FIX: MANUAL (▇)<br>SOURCE: VERT MODE<br>COUPLING: AC<br>SLOPE CH1/CH2: +/+<br>TRIG LEVEL: Pushed in, AUTO<br>MODE: CH1 | 1. Set TRIG LEVEL to 12 o'clock position.<br>2. Apply a 1kHz sine wave signal to CH1 input to display a waveform of 4 to 6 divisions vertical amplitude.<br>3. Operate ↕ POSITION to move the waveform so that its amplitude is equally above and below the horizontal center graticule line.<br>4. Adjust VR1 so that the start point of waveform is on the horizontal center graticule line.<br>(Check)<br>1. When CH1 and CH2 SLOPE is alternately turned to (+) and (−), the start point must be always on the horizontal center graticule line.<br>2. With SLOPE remaining in the position of (+), when turned TRIG LEVEL to CW toward 3 o'clock from near 9 o'clock, the waveform is as shown at right.<br>3. Adjust the oscillator output so that the waveform amplitude becomes 0.5 division and make sure that synchronization can be obtained by TRIG LEVEL. |  100<br>90<br>10<br>0<br>Align the starting point with the horizontal center graticule line<br>SLOPE (+)<br>SLOPE (−)<br>TRIG LEVEL at 3 o'clock position<br>TRIG LEVEL at 12 o'clock position<br>TRIG LEVEL at 9 o'clock position. | |

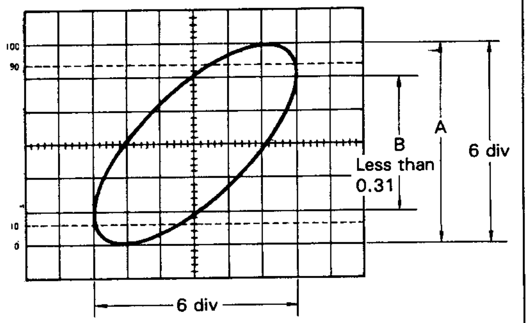
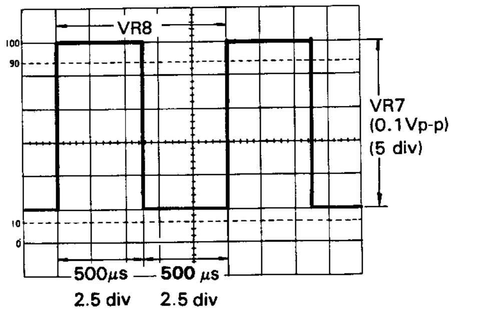
# ADJUSTMENT

<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B. No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr><td>Adjustment of Trig Level (2)</td><td>VR10<br>VR12<br>VR13</td><td>X73-1420</td><td>SG-502</td><td>CH1, CH2, AC-GND-DC: AC<br>CH1, CH2, VOLTS/DIV: 5mV<br>SWEEP TIME/DIV: 0.2ms<br>MANUAL/FIX: MANUAL (■)<br>SOURCE: VERT MODE<br>COUPLING: AC<br>SLOPE CH1/CH2: +/+<br>TRIG LEVEL: Pushed in, AUTO<br>MODE: CH1</td><td>1. Apply a 1kHz sine wave signal to CH1 input to display a waveform of 4 to 6 divisions vertical amplitude.<br>2. Operate ↕ POSITION to move the waveform so that its amplitude is equally above and below the horizontal center graticule line.<br>3. Operate TRIG LEVEL knob so that the start point of the waveform is on the horizontal center graticule line.<br>4. When COUPLING is changed from AC to DC in each range of SOURCE in VERT MODE, CH1 and CH2, adjust VR10, VR12 and VR13 so that the start point of the waveform is located on the horizontal center graticule line.<br>VERT MODE..................VR10<br>CH1..............................VR12<br>CH2..............................VR13<br>5. Adjust the oscillator output to display a sine waveform of less than 1 division amplitude and carry out step (4) above again in the center of the screen.</td><td></td><td></td></tr>
<tr><td>Checking of Trig Sensitivity</td><td></td><td></td><td>SG-502<br>SG-503<br>CG-911</td><td></td><td>(I) INT<br>1. Apply a sine wave signal to CH1 input, vary the oscillator output and operate TRIG LEVEL to measure the minimum synchronization amplitude on the screen.<br>Confirm synchronization by each check frequency.<br>2. Check CH2 as for CH1 above.<br>(II) VIDEO<br>1. Apply a VIDEO signal to CH1 input, vary the oscillator output and operate TRIG LEVEL to measure and check the minimum synchronization amplitude on the screen.<br>Confirm synchronization by each check frequency.<br>2. Check CH2 as for CH1 above.<br>(III) EXT<br>1. Apply a signal synchronized to CH1 input to EXT input and adjust the oscillator output to measure and check the minimum amplitude.<br>2. Check CH2 as for CH1 above.</td><td></td><td></td></tr>
<tr><td>Checking of Trig Source</td><td></td><td></td><td></td><td></td><td>The selection of trigger signal should be carried out according to combination of vertical axis mode and source as follows.
<table>
<tr><th rowspan="2">SOURCE / VERT MODE</th><th colspan="2">VERT MODE</th><th rowspan="2">CH1</th><th rowspan="2">CH2</th><th rowspan="2">LINE</th><th rowspan="2">EXT</th></tr>
<tr><th>EXCLUDING VERT MODE</th><th>VIDEO</th></tr>
<tr><td>CH1</td><td>CH1</td><td>CH1</td><td rowspan="6">CH1</td><td rowspan="6">CH2</td><td rowspan="6">LINE</td><td rowspan="6">EXT</td></tr>
<tr><td>CH2</td><td>CH2</td><td>CH2</td></tr>
<tr><td rowspan="2">ALT</td><td>CH1 : CH1</td><td>CH1</td></tr>
<tr><td>CH2 : CH2</td><td>See note (1)</td></tr>
<tr><td>CHOP</td><td colspan="2">See note (2)</td></tr>
<tr><td>ADD</td><td>(CH1+CH2)</td><td>(CH1+CH2)</td></tr>
</table>
(Note)<br>1. In the case of VIDEO FRAME, the alternate trace of CH1 and CH2 appear on the screen, but both CH1 and CH2 display are triggered with CH1 signal only.<br>2. As the CHOP change-over signal becomes the trigger signal, triggering is not properly carried out.<br>In this case, set SOURCE excluding VERT MODE.</td><td></td><td></td></tr>
</table>

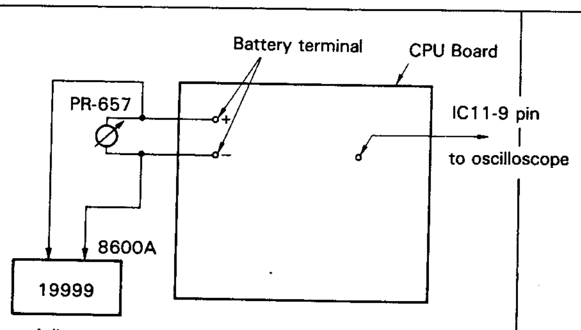
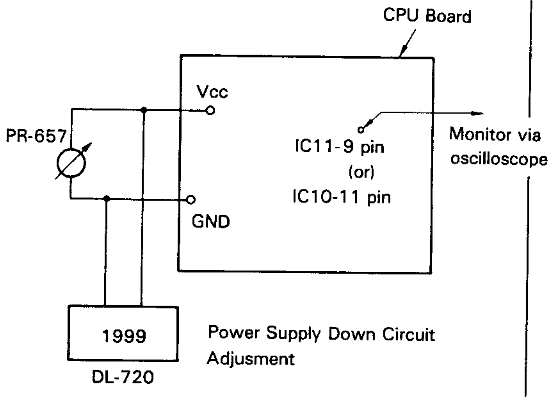
# ADJUSTMENT

<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B. No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr><td><b>Checking of Trig Slope</b></td><td></td><td></td><td></td><td></td><td>1. The setting of trig slope is described according to combination of vertical axis mode and source.<br>Check that the trigger signal is operated in SLOPE CH1 +/− and CH2 +/− as follows.
<table>
<tr><th>SEPARATE</th><th>SOURCE<br>VERT MODE</th><th>VERT MODE</th><th>CH1</th><th>CH2</th><th>LINE, EXT</th></tr>
<tr><td rowspan="2">ON</td><td>CH1</td><td>Main:CH1 +/−<br>Sub:CH2 +/−</td><td rowspan="2">CH1 +/−</td><td rowspan="2">CH2 +/−</td><td>Main:CH1 +/−<br>Sub:CH2 +/−</td></tr>
<tr><td>CH2</td><td>Main:CH2 +/−<br>Sub:CH1 +/−</td><td>Main:CH2 +/−<br>Sub:CH1 +/−</td></tr>
<tr><td rowspan="5">OFF</td><td>CH1</td><td>CH1 +/−</td><td rowspan="5">CH1 +/−</td><td rowspan="5">CH2 +/−</td><td>CH1 +/−</td></tr>
<tr><td>CH2</td><td>CH2 +/−</td><td>CH2 +/−</td></tr>
<tr><td>ALT</td><td>CH1:CH1 +/−<br>CH2:CH2 +/−</td><td>CH1:CH1 +/−<br>CH2:CH2 +/−</td></tr>
<tr><td>CHOP</td><td rowspan="2">CH1 +/−</td><td rowspan="2">CH1 +/−</td></tr>
<tr><td>ADD</td></tr>
</table>
2. In the case of VIDEO, FRAME, check that the odd and even fields can be selected.</td><td></td><td></td></tr>
<tr><td><b>Checking of Trig Mode</b></td><td></td><td></td><td></td><td></td><td>The trig mode is decided according to combination of FIX/MANUAL, TRIG LEVEL and AUTO/NORMAL as shown table below.
<table>
<tr><th>TRIG LEVEL<br>FIX/MANUAL</th><th>AUTO (PUSH)</th><th>NORMAL (PULL)</th></tr>
<tr><td>FIX</td><td>Auto sweep<br>Level fix</td><td>Triggered sweep<br>Level adjustable</td></tr>
<tr><td>MANUAL</td><td>Auto sweep<br>Level adjustable</td><td>Triggered sweep<br>Level adjustable</td></tr>
</table></td><td></td><td></td></tr>
<tr><td><b>Checking of Jitter</b></td><td></td><td></td><td>SG-503</td><td>CH1, AC-GND-DC: AC<br>CH1, VOLTS/DIV: 5mV<br>SWEEP TIME/DIV: 0.2ms<br>×5 MAG: Pushed in<br>MANUAL/FIX: MANUAL (■)<br>SOURCE: CH1<br>COUPLING: CH1</td><td>1. Apply a 20MHz sine wave signal to CH1 input and adjust the oscillator output to display a waveform of 4 divisions vertical amplitude.<br>2. Operate TRIG LEVEL to find a point where the jitter is minimized.<br>Jitter: within 0.25div</td><td> </td><td></td></tr>
<tr><td colspan="8"><b>ADJUSTMENT OF X-Y OPERATION</b></td></tr>
<tr><td><b>Adjustment of X axis Gain</b></td><td>VR7</td><td>X73-1420</td><td>PG-506</td><td>CH1, AC-GND-DC: GND<br>CH2, AC-GND-DC: AC<br>CH2, VOLTS/DIV: 2mV<br>SWEEP TIME/DIV: X-Y</td><td>Apply a 10mVp-p square wave signal to CH2 input and adjust VR7 to display a waveform of 5 divisions vertical amplitude.<br>(Check)<br>Specification: 5 div within ±5%</td><td></td><td></td></tr>
</table>

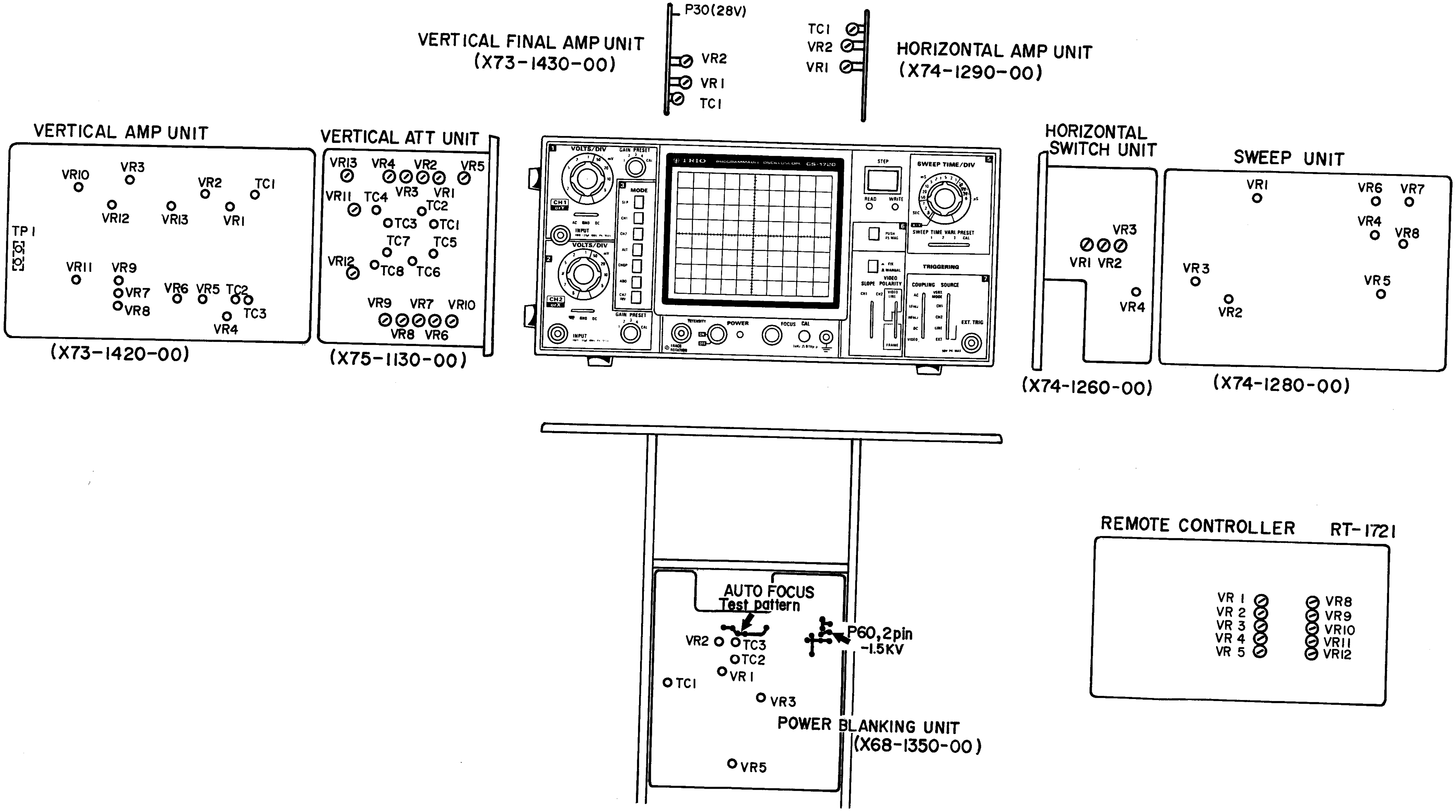
# ADJUSTMENT

| Item | Adjustment Control | P.C.B. No. | Test Equipment | Control Setting | Adjustment and Check | Illustration | Remark |
|---|---|---|---|---|---|---|---|
| **Adjustment of X axis Position Center** | VR8 | X73-1420 | | CH1, CH2, AC-GND-DC: GND<br>CH1, CH2, VOLTS/DIV: 2mV<br>MODE: ALT<br>SOURCE: CH1 | 1. Operate ⬍ POSITION to align the traces on the horizontal center graticule line.<br>2. When selected SWEEP TIME/DIV to X-Y, adjust VR8 to bring the spot on the center of the CRT screen.<br>(Check)<br>1. When ◄► POSITION is turned to CCW, the spot should move leftward more than 5 divisions and to CW, it should move rightward more than 5 divisions.<br>Error between the spot and the center of the screen: within ±1div from the center of the screen. | | |
| **Checking of X axis Frequency Characteristics** | | | SG-502 | CH2, AC-GND-DC: DC<br>CH2, VOLTS/DIV: 2mV<br>SWEEP TIME/DIV: X-Y | 1. Apply a 1kHz sine wave signal to CH2 input and adjust the oscillator output to display a waveform of 10 divisions vertical amplitude on the screen.<br>2. When the frequency is varied to 2MHz without changing the oscillator output, the amplitude must be more than 7.1 divisions (−3dB).<br>Frequency characteristic: DC-2MHz (−3dB) | | |
| **Checking of X-Y Phase difference** | | | SG-502 | CH1, CH2, AC-GND-DC: AC<br>CH1, CH2, VOLTS/DIV: 2mV | 1. Operate CH1 and CH2 to align the traces on the horizontal center graticule line.<br>2. Apply a 100kHz sine wave signal to both CH1 and CH2 inputs to display a waveform of 6 divisions vertical amplitude on the screen.<br>3. When selected SWEEP TIME/DIV to X-Y, check the value of (B) referring to Lissajous' waveform should be within 0.31.<br>Specification: less than 3° at 100kHz |  100<br>90<br>10<br>0<br>B<br>Less than 0.31<br>A<br>6 div<br>6 div | Sin $\phi = \frac{B}{A}$<br>$\phi$=Phase angle |
| **Adjustment of CAL Output** | VR7<br>VR8 | | X74-1280 | CH1, AC-GND-DC: DC<br>CH1, VOLTS/DIV: 0.2mV | 1. Apply the CAL terminal voltage to CH1 input and adjust VR7 so the value becomes 0.1V±2%.<br>2. Adjust VR8 so that the frequency becomes 1kHz.<br>Specifications: frequency; 1kHz±5%<br>output voltage; 0.1Vp-p±2%<br>duty ratio; (50±2)% |  VR8<br>100<br>90<br>10<br>0<br>VR7<br>(0.1Vp-p)<br>(5 div)<br>500μs<br>2.5 div<br>500 μs<br>2.5 div | |
| **Checking of CH1 OUT Frequency Characteristic** | | | SG-503<br>475A<br>50Ω termination | CH1, AC-GND-DC: AC<br>CH1, VOLTS/DIV: 2mV | 1. Apply a 50kHz sine wave signal to CH1 input and adjust the oscillator output to display a waveform of 8 divisions vertical amplitude.<br>2. Connect the CH1 OUT to CH1 input of oscilloscope (475A) through 50Ω termination to display a waveform of 5 to 6 divisions vertical amplitude on the screen.<br>(475A vertical sensitivity; 0.2V/div, AC coupling)<br>3. When the frequency is varied to 20MHz without changing the oscillator output, the amplitude of 475A must be within 5.6 divisions (−3dB). | | |
| **Checking of CH1 OUT output voltage and output impedance** | | | SG-503<br>475A<br>50Ω termination | CH1, AC-GND-DC: AC<br>CH1, VOLTS/DIV: 2mV | 1. When applied a 50kHz sine wave signal to CH1 input, the amplitude of 475A must be more than 800mVp-p.<br>2. When disconnected 50Ω termination from 475A input, the amplitude must be 2 times.<br>Specifications: output voltage; more than 100mVp-p/div<br>output impedance; 50Ω±20% | | |

# ADJUSTMENT

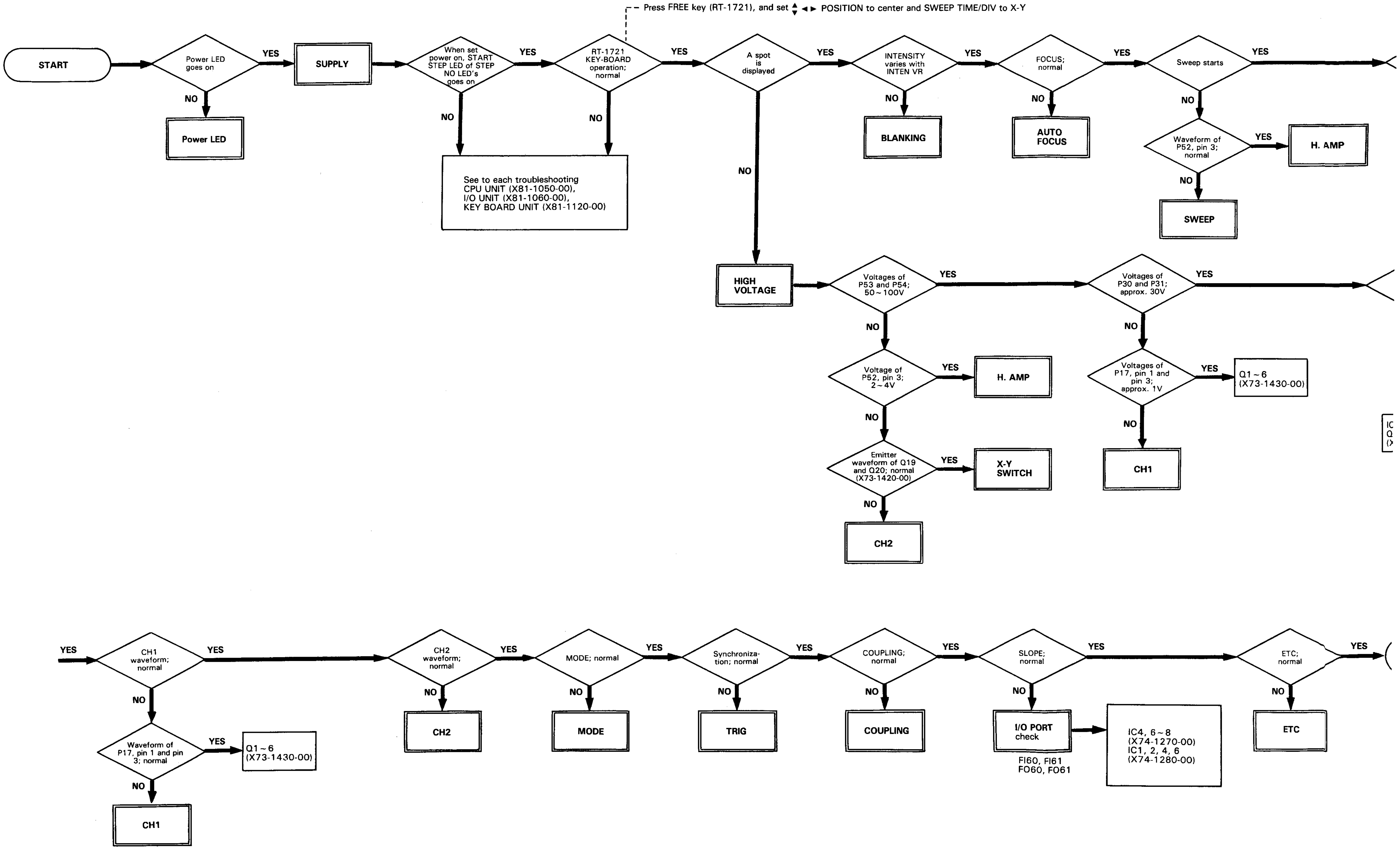
| Item | Adjustment Control | P.C.B. No. | Test Equipment | Control Setting | Adjustment and Check | Illustration | Remark |
|---|---|---|---|---|---|---|---|
| **Checking of SWEEP OUT Operation** | P50 | X74-1280 | 475A<br>50Ω termination | SWEEP TIME/DIV: 1ms | 1. When observed the waveform at P50, using 475A through 50Ω termination, the amplitude must be more than 1Vp-p. (475A vertical sensitivity; 1mV/div, AC coupling)<br>2. When disconnected 50Ω termination from 475A input, the amplitude must be 2 times.<br>Specifications: output voltage; more than 1Vp-p (50Ω terminate)<br>output impedance; 50Ω±20% | | |
| **Checking of SWEEP GATE Operation** | P51 | X74-1280 | | | Measure the waveform of P51 and check that the square waveform synchronized to SWEEP OUT is taken out.<br>The output voltage is TTL level and in the case of sweep operation, is zero level. | | |
| **ADJUSTMENT OF CPU BOARD** | | | | | | | |
| **Battery Down Detection Circuit** | VR1 | X81-1050 | PR-657<br>8600A<br>475A | | The same with respect to memory pack<br>1. Connect the PR-657 in place of the battery and monitor its output with the 8600A. Also monitor the 9 pin of IC11 above the CPU board with the oscilloscope.<br>Set the PR-657 at 2.5 V and turn VR1 so that the output of the 9 pin is at low level.<br>2. Next turn VR1 until the 9 pin changes from low to high level, then stop VR1 at the high level point.<br>Finally, slowly lower the PR-657 output from 5 V and confirm that the voltage is at 2.5 V±20 mV when the 9 pin changes from low to high level. |   Battery terminal<br>CPU Board<br>PR-657<br>+<br>–<br>IC11-9 pin<br>to oscilloscope<br>8600A<br>19999 Adjustment wiring (Battery down detection circuit) | |
| **Power Supply Down Circuit** | VR2 | X81-1050 | PR-657<br>DL-720<br>475A | | 1. Connect the PR-657 as the CPU board power supply, and monitor its voltage with DL-720.<br>Set the PR-657 at 4.7 V and turn VR2 so that the IC11, 6 pin is at low level.<br>2. Next, turn VR2 so that the 6 pin of IC11 changes from low to high level, then stop VR2 at the high level point.<br>Finally, set the PR-657 at 5 V, slowly lower the voltage and confirm that the voltage reversing from low to high is at 4.7 V±50 mV. |   CPU Board<br>Vcc<br>PR-657<br>IC11-9 pin<br>(or)<br>IC10-11 pin<br>Monitor via oscilloscope<br>GND<br>1999<br>DL-720 Power Supply Down Circuit Adjusment | |

# ADJUSTMENT

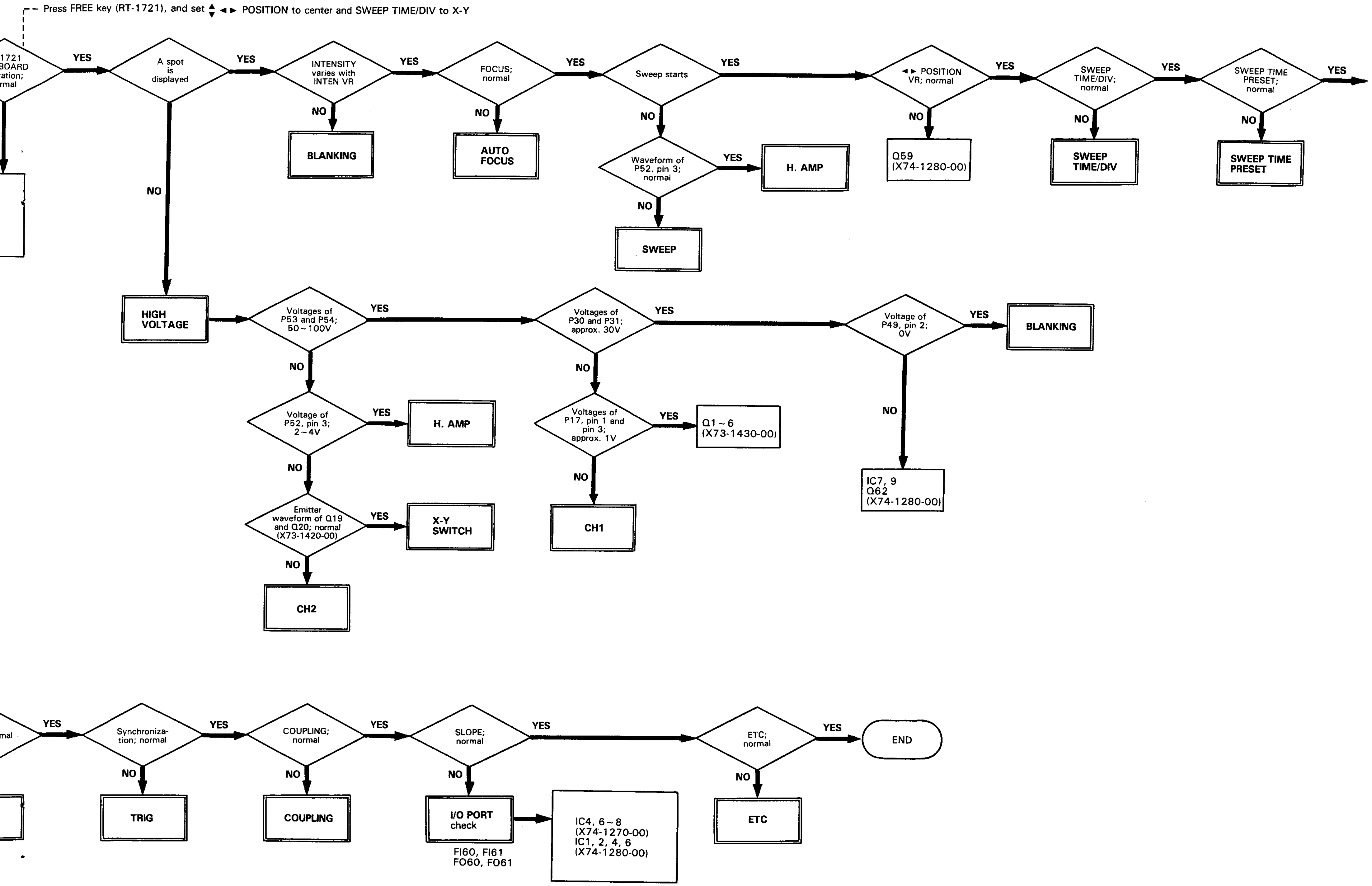

VERTICAL FINAL AMP UNIT
(X73-1430-00)
P30(28V)
VR2
VR1
TC1
TC1
VR2
VR1
HORIZONTAL AMP UNIT
(X74-1290-00)
VERTICAL AMP UNIT
VR10
VR3
VR2
TC1
VR12
VR13
VR1
TP1
VR11
VR9
VR7
VR8
VR6
VR5
TC2
TC3
VR4
(X73-1420-00)
VERTICAL ATT UNIT
VR13
VR4
VR2
VR5
VR11
TC4
VR3
VR1
TC2
TC3
TC1
TC7
TC5
VR12
TC8
TC6
VR9
VR7
VR10
VR8
VR6
(X75-1130-00)
HORIZONTAL SWITCH UNIT
VR3
VR1 VR2
VR4
(X74-1260-00)
SWEEP UNIT
VR1
VR6
VR7
VR4
VR8
VR3
VR5
VR2
(X74-1280-00)
AUTO FOCUS
Test pattern
VR2
TC3
TC2
VR1
TC1
VR3
P60,2pin
-1.5KV
POWER BLANKING UNIT
(X68-1350-00)
VR5
REMOTE CONTROLLER RT-1721
VR1
VR2
VR3
VR4
VR5
VR8
VR9
VR10
VR11
VR12

LOCATION OF ADJUSTMENT CONTROL

# TROUBLESHOOTING

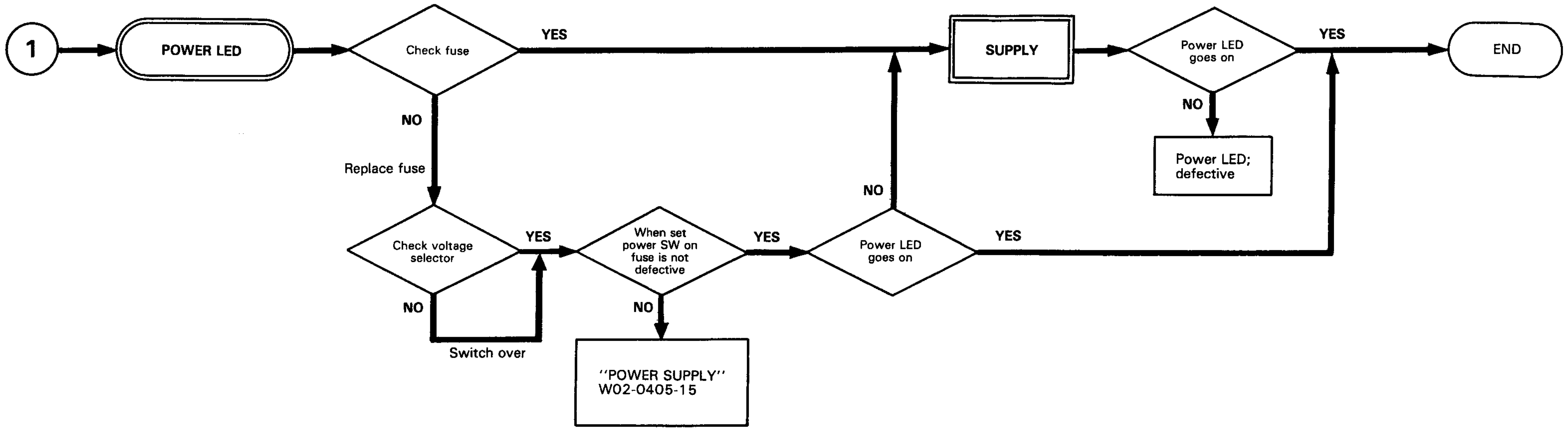

Press FREE key (RT-1721), and set ▲▼ ◄► POSITION to center and SWEEP TIME/DIV to X-Y
START
Power LED goes on
YES
NO
Power LED
SUPPLY
When set power on, START STEP LED of STEP NO LED's goes on
YES
NO
RT-1721 KEY-BOARD operation; normal
YES
NO
See to each troubleshooting
CPU UNIT (X81-1050-00),
I/O UNIT (X81-1060-00),
KEY BOARD UNIT (X81-1120-00)
A spot is displayed
YES
NO
INTENSITY varies with INTEN VR
YES
NO
BLANKING
FOCUS; normal
YES
NO
AUTO FOCUS
Sweep starts
YES
NO
Waveform of P52, pin 3; normal
YES
H. AMP
NO
SWEEP
HIGH VOLTAGE
Voltages of P53 and P54; 50～100V
YES
NO
Voltage of P52, pin 3; 2～4V
YES
H. AMP
NO
Emitter waveform of Q19 and Q20; normal (X73-1420-00)
YES
X-Y SWITCH
NO
CH2
Voltages of P30 and P31; approx. 30V
YES
NO
Voltages of P17, pin 1 and pin 3; approx. 1V
YES
Q1～6 (X73-1430-00)
NO
CH1
YES
CH1 waveform; normal
YES
NO
Waveform of P17, pin 1 and pin 3; normal
YES
Q1～6 (X73-1430-00)
NO
CH1
CH2 waveform; normal
YES
NO
CH2
MODE; normal
YES
NO
MODE
Synchronization; normal
YES
NO
TRIG
COUPLING; normal
YES
NO
COUPLING
SLOPE; normal
YES
NO
I/O PORT check
FI60, FI61
FO60, FO61
IC4, 6～8
(X74-1270-00)
IC1, 2, 4, 6
(X74-1280-00)
ETC; normal
YES
NO
ETC

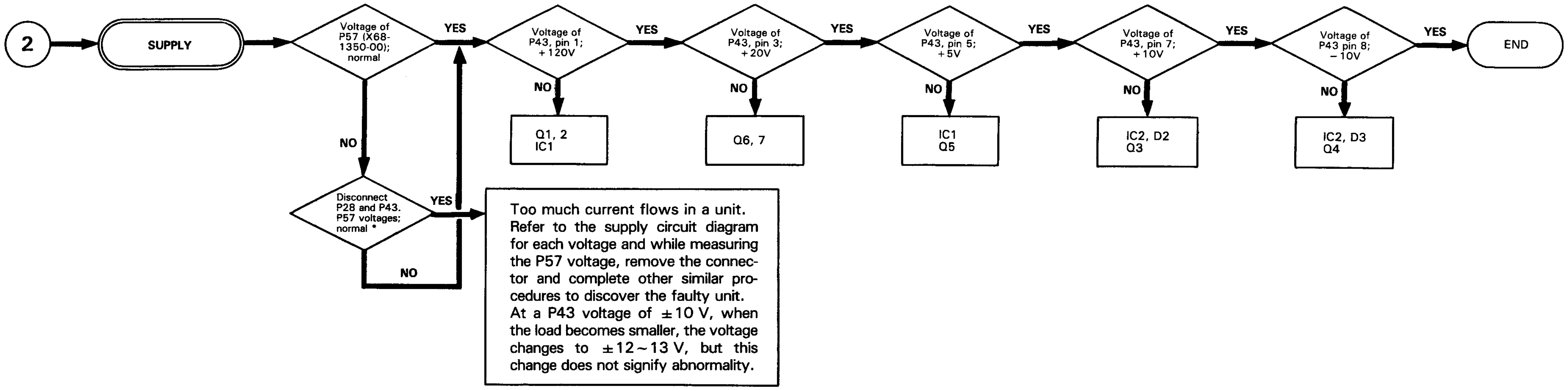
# TROUBLESHOOTING



Press FREE key (RT-1721), and set ▲▼ ◄► POSITION to center and SWEEP TIME/DIV to X-Y
1721
BOARD
ation;
rmal
YES
A spot is displayed
YES
INTENSITY varies with INTEN VR
YES
FOCUS; normal
YES
Sweep starts
YES
◄► POSITION VR; normal
YES
SWEEP TIME/DIV; normal
YES
SWEEP TIME PRESET; normal
YES
NO
BLANKING
NO
AUTO FOCUS
NO
Waveform of P52, pin 3; normal
YES
H. AMP
NO
SWEEP
NO
Q59 (X74-1280-00)
NO
SWEEP TIME/DIV
NO
SWEEP TIME PRESET
NO
HIGH VOLTAGE
Voltages of P53 and P54; 50~100V
YES
Voltages of P30 and P31; approx. 30V
YES
Voltage of P49, pin 2; 0V
YES
BLANKING
NO
Voltage of P52, pin 3; 2~4V
YES
H. AMP
NO
Emitter waveform of Q19 and Q20; normal (X73-1420-00)
YES
X-Y SWITCH
NO
CH2
NO
Voltages of P17, pin 1 and pin 3; approx. 1V
YES
Q1~6 (X73-1430-00)
NO
CH1
NO
IC7, 9
Q62
(X74-1280-00)
mal
YES
Synchronization; normal
YES
COUPLING; normal
YES
SLOPE; normal
YES
ETC; normal
YES
END
NO
TRIG
NO
COUPLING
NO
I/O PORT check
FI60, FI61
FO60, FO61
IC4, 6~8
(X74-1270-00)
IC1, 2, 4, 6
(X74-1280-00)
NO
ETC

# TROUBLESHOOTING


1
POWER LED
Check fuse
YES
NO
Replace fuse
SUPPLY
Power LED goes on
YES
END
NO
Power LED; defective
Check voltage selector
YES
NO
Switch over
When set power SW on fuse is not defective
YES
NO
"POWER SUPPLY" W02-0405-15
Power LED goes on
NO
YES

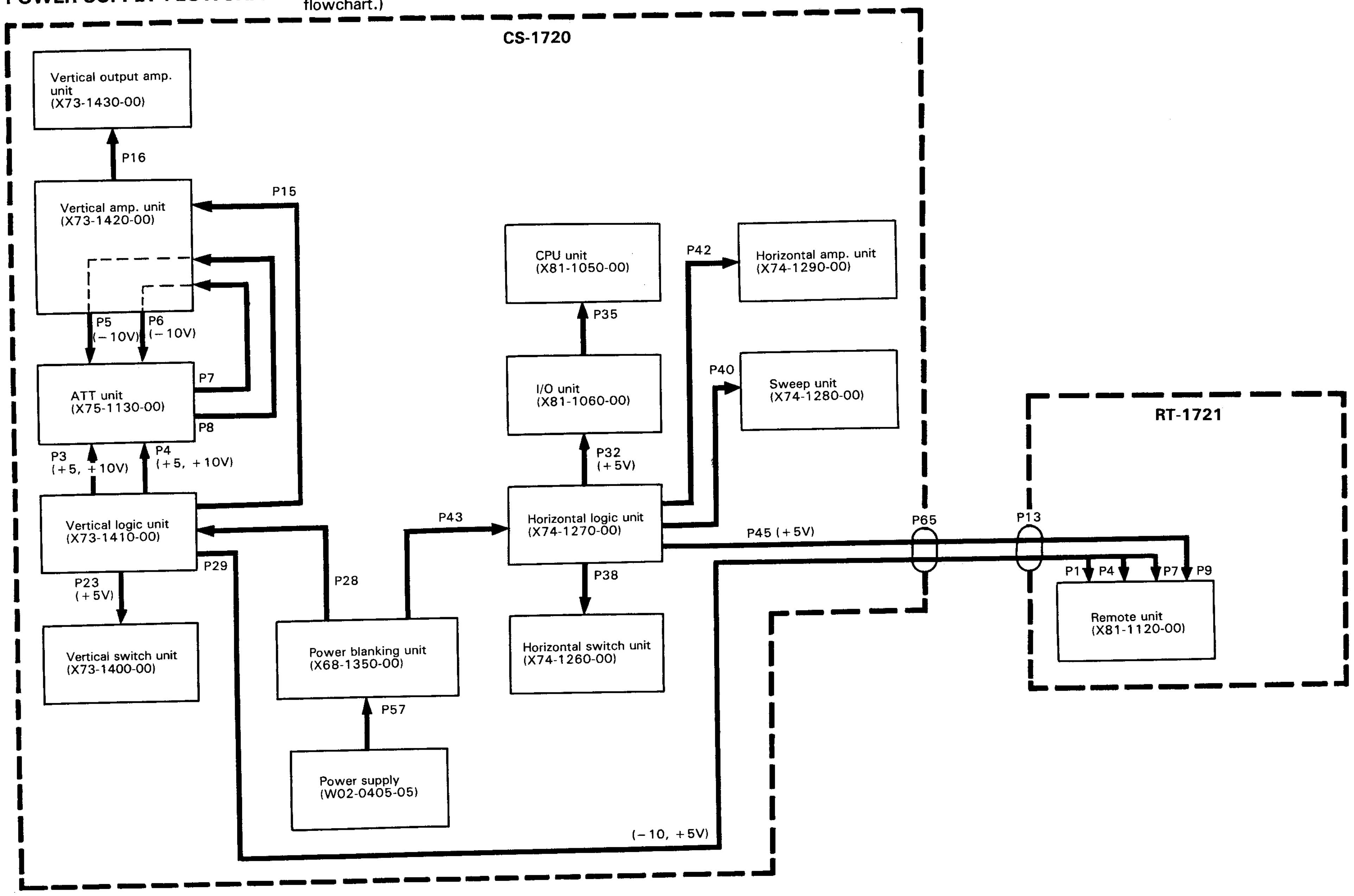

2
SUPPLY
Voltage of P57 (X68-1350-00); normal
YES
NO
Disconnect P28 and P43. P57 voltages; normal *
YES
NO
Voltage of P43, pin 1; +120V
YES
NO
Q1, 2 IC1
Voltage of P43, pin 3; +20V
YES
NO
Q6, 7
Voltage of P43, pin 5; +5V
YES
NO
IC1 Q5
Voltage of P43, pin 7; +10V
YES
NO
IC2, D2 Q3
Voltage of P43 pin 8; −10V
YES
NO
IC2, D3 Q4
END

Too much current flows in a unit. Refer to the supply circuit diagram for each voltage and while measuring the P57 voltage, remove the connector and complete other similar procedures to discover the faulty unit. At a P43 voltage of ±10 V, when the load becomes smaller, the voltage changes to ±12~13 V, but this change does not signify abnormality.

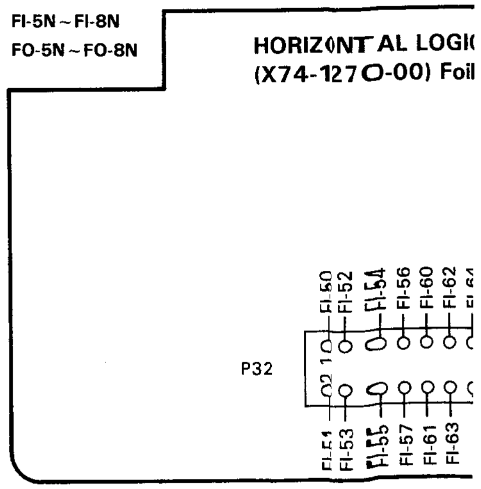
*Be sure to measure for short time and connect P28 and P43 immediately.

## POWER SUPPLY FLOWCHART

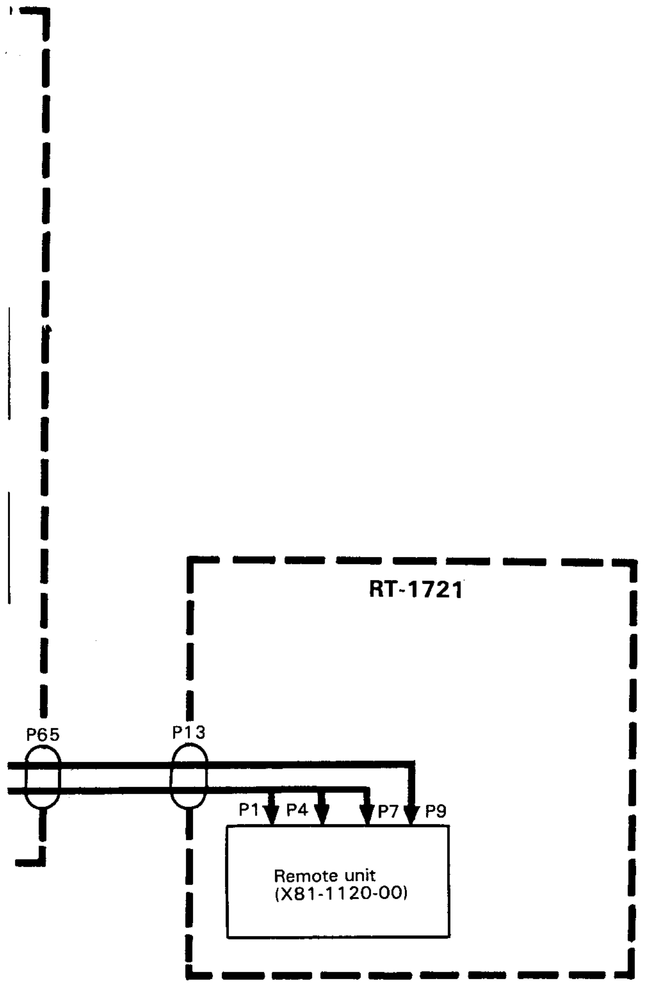
(If the power supply voltage is not normal, find the defective unit referring to the below flowchart.)

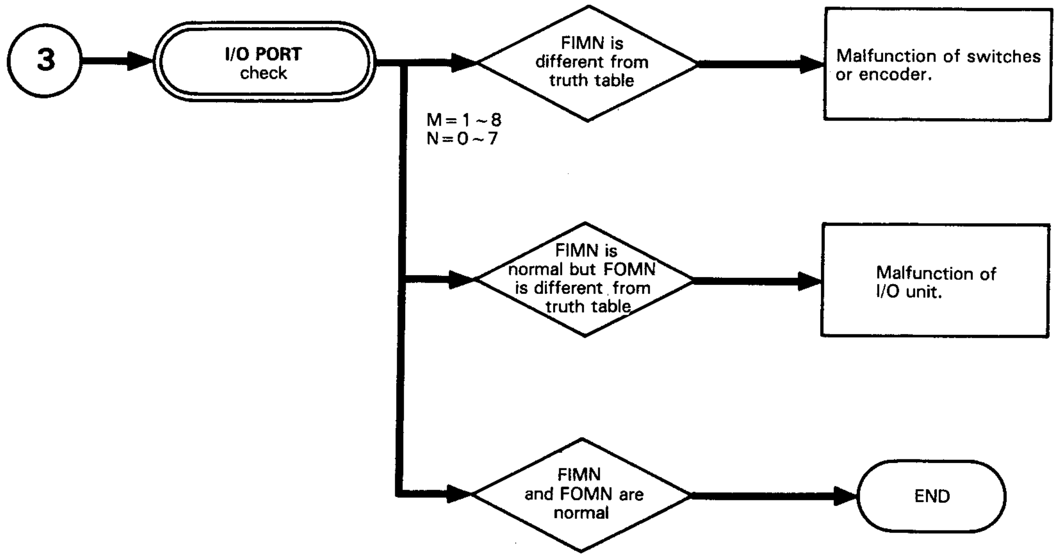

CS-1720
Vertical output amp. unit (X73-1430-00)
P16
Vertical amp. unit (X73-1420-00)
P15
P5 (−10V)
P6 (−10V)
ATT unit (X75-1130-00)
P7
P8
P3 (+5, +10V)
P4 (+5, +10V)
Vertical logic unit (X73-1410-00)
P29
P23 (+5V)
Vertical switch unit (X73-1400-00)
P28
Power blanking unit (X68-1350-00)
P57
Power supply (W02-0405-05)
P43
CPU unit (X81-1050-00)
P35
I/O unit (X81-1060-00)
P32 (+5V)
Horizontal logic unit (X74-1270-00)
P38
Horizontal switch unit (X74-1260-00)
P42
Horizontal amp. unit (X74-1290-00)
P40
Sweep unit (X74-1280-00)
P45 (+5V)
(−10, +5V)
P65
P13
RT-1721
P1 P4 P7 P9
Remote unit (X81-1120-00)

3
I/O PORT check


FI-5N ~ FI-8N
FO-5N ~ FO-8N
HORIZONTAL LOGI
(X74-1270-00) Foil
P32
FI-52
FI-54
FI-56
FI-60
FI-62
FI-53
FI-55
FI-57
FI-61
FI-63

he below


RT-1721
P65
P13
P1
P4
P7
P9
Remote unit
(X81-1120-00)


3
I/O PORT
check
M=1~8
N=0~7
FIMN is different from truth table
Malfunction of switches or encoder.
FIMN is normal but FOMN is different from truth table
Malfunction of I/O unit.
FIMN and FOMN are normal
END

**Note:**

(1) Select the remote controller (RT-1721) to FREE position.

(2) Before checking of I/O PORT, carry out the following procedures.

- (a) FI-1N~FI-4N (X73-1410-00) (N=0~7)
  Remove the connector of flat cable connected to P25 and check the voltage of P25.
- (b) FO-1N~FO-4N (X81-1060-00)
  Remove the connector of flat cable connected to P26 and check the voltage of P26.
- (c) FI-5N~FI-8N, FO-5N~FO-8N (X74-1270-00)
  Check the voltage of P32 (Horizontal Logic Unit).

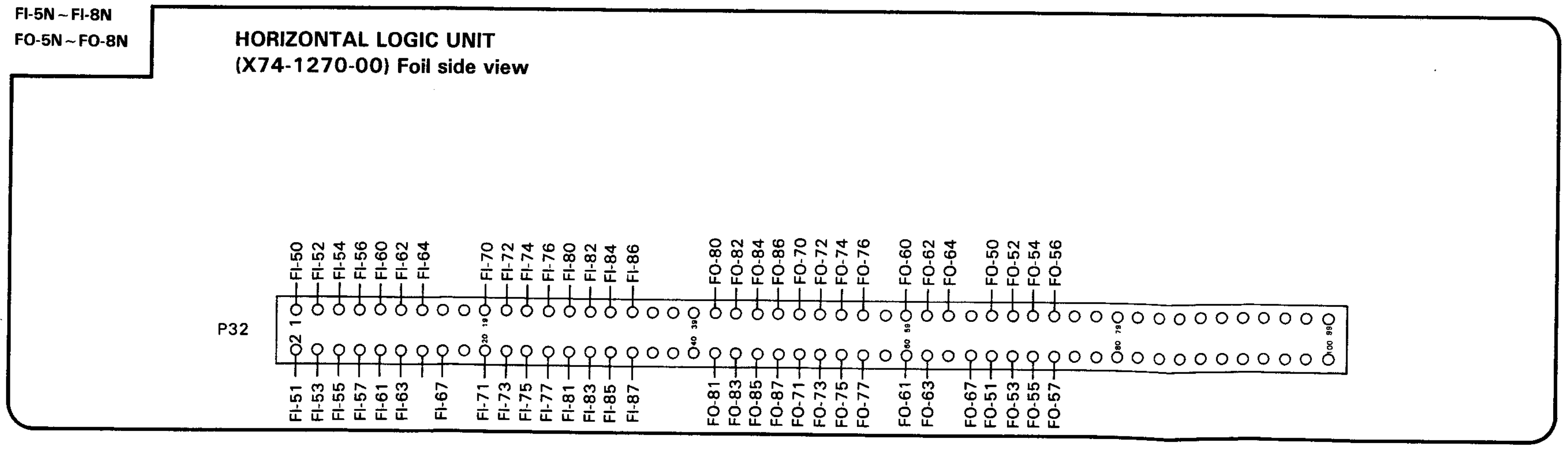

FI-5N~FI-8N
FO-5N~FO-8N
HORIZONTAL LOGIC UNIT
(X74-1270-00) Foil side view
P32
1
2
FI-50
FI-52
FI-54
FI-56
FI-60
FI-62
FI-64
FI-70
FI-72
FI-74
FI-76
FI-80
FI-82
FI-84
FI-86
FO-80
FO-82
FO-84
FO-86
FO-70
FO-72
FO-74
FO-76
FO-60
FO-62
FO-64
FO-50
FO-52
FO-54
FO-56
FI-51
FI-53
FI-55
FI-57
FI-61
FI-63
FI-67
FI-71
FI-73
FI-75
FI-77
FI-81
FI-83
FI-85
FI-87
FO-81
FO-83
FO-85
FO-87
FO-71
FO-73
FO-75
FO-77
FO-61
FO-63
FO-67
FO-51
FO-53
FO-55
FO-57

Fig. 9-1 Location of I/O Port

## Table 9-1 Input/Output Port Map

| | | | bit 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | FI-1 | FO-1 | CH1 AC/DC | CH1 VOLTS / DIV | | | | CH1 GAIN PRESET | | |
| | | | $\overline{\text{DC}}$ | $\overline{\text{1/100}}$ | $\overline{\text{1/10}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ | C | B | A |
| 2 | FI-2 | FO-2 | CH2 AC/DC | CH2 VOLTS / DIV | | | | CH2 GAIN PRESET | | |
| | | | $\overline{\text{DC}}$ | $\overline{\text{1/100}}$ | $\overline{\text{1/10}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ | C | B | A |
| 3 | FI-3 | FO-3 | MODE | | | | | | | |
| | | | | $\overline{\text{INV}}$ | $\overline{\text{ADD}}$ | $\overline{\text{CHOP}}$ | $\overline{\text{ALT}}$ | $\overline{\text{CH2}}$ | $\overline{\text{CH1}}$ | SEP |
| 4 | FI-4 | FO-4 | | | CH2 POSITION PRESET | | | CH1 POSITION PRESET | | |
| | | | | | $\overline{\text{C}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ | $\overline{\text{C}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ |
| 5 | FI-5 | FO-5 | SWEEP TIME VARI. PRESET | | SWEEP TIME / DIV (RT) | | | (CT) | | |
| | | | $\overline{\text{B}}$ | $\overline{\text{A}}$ | $\overline{\text{C}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ | $\overline{\text{C}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ |
| 6 | FI-6 | FO-6 | ×5 MAG | | | FIX | VIDEO POLARITY | | SLOPE | |
| | | | ×5MAG | | | FIX | $\overline{\text{TV.H}}$ | $\overline{\text{TV(+)}}$ | $\overline{\text{CH2(−)}}$ | $\overline{\text{CH1(−)}}$ |
| 7 | FI-7 | FO-7 | EXT. TRIG* | | SOURCE | | | COUPLING | | |
| | | | $\overline{\text{B}}$ | $\overline{\text{A}}$ | $\overline{\text{C}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ | $\overline{\text{C}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ |
| 8 | FI-8 | FO-8 | CH2 INPUT* | | | | CH1 INPUT* | | | |
| | | | $\overline{\text{D}}$ | $\overline{\text{C}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ | $\overline{\text{D}}$ | $\overline{\text{C}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ |

*For Using Probe Selector

## Table 9-2 Control Signal Truth Table

**1**

| FI -1– / FO-1– | | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|
| | | CH1 AC/DC | CH1 VOLTS / DIV | | | | CH1 GAIN PRESET | | |
| | | $\overline{\text{DC}}$ | $\overline{\text{1/100}}$ | $\overline{\text{1/10}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ | C | B | A |
| CH1 AC-GND-DC | AC | H | | | | | | | |
| | DC | L | | | | | | | |
| CH1 VOLTS/DIV | 5V | | L | L | H | L | | | |
| | 2V | | L | L | L | H | | | |
| | 1V | | L | H | H | H | | | |
| | 0.5V | | L | H | H | L | | | |
| | 0.2V | | L | H | L | H | | | |
| | 0.1V | | H | L | H | H | | | |
| | 50mV | | H | L | H | L | | | |
| | 20mV | | H | L | L | H | | | |
| | 10mV | | H | H | H | H | | | |
| | 5mV | | H | H | H | L | | | |
| | 2mV | | H | H | L | H | | | |
| CH1 GAIN VARIABLE PRESET | 1 | | | | | | L | L | L |
| | 2 | | | | | | L | L | H |
| | 3 | | | | | | L | H | L |
| | 4 | | | | | | L | H | H |
| | CAL | | | | | | H | L | L |

**2**

| FI -2– / FO-2– | | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|
| | | CH2 AC/DC | CH2 VOLTS / DIV | | | | CH2 GAIN PRESET | | |
| | | $\overline{\text{DC}}$ | $\overline{\text{1/100}}$ | $\overline{\text{1/10}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ | C | B | A |
| CH2 AC-GND-DC | AC | H | | | | | | | |
| | DC | L | | | | | | | |
| CH2 VOLTS/DIV | 5V | | L | L | H | L | | | |
| | 2V | | L | L | L | H | | | |
| | 1V | | L | H | H | H | | | |
| | 0.5V | | L | H | H | L | | | |
| | 0.2V | | L | H | L | H | | | |
| | 0.1V | | H | L | H | H | | | |
| | 50mV | | H | L | H | L | | | |
| | 20mV | | H | L | L | H | | | |
| | 10mV | | H | H | H | H | | | |
| | 5mV | | H | H | H | L | | | |
| | 2mV | | H | H | L | H | | | |
| CH2 GAIN VARIABLE PRESET | 1 | | | | | | L | L | L |
| | 2 | | | | | | L | L | H |
| | 3 | | | | | | L | H | L |
| | 4 | | | | | | L | H | H |
| | CAL | | | | | | H | L | L |

**3**

| FI -3– / FO-3– | | | 7 | 6 | 5 |
|---|---|---|---|---|---|
| | | | | | |
| | | | | $\overline{\text{INV}}$ | $\overline{\text{ADD}}$ |
| MODE | CH2 INV | OFF | | H | |
| | | ON | | L | |
| | CH1 | | | | H |
| | CH2 | | | | H |
| | ALT | | | | H |
| | CHOP | | | | H |
| | ADD | | | | L |
| | SEP | OFF | | | |
| | | ON | | | |

**5**

| FI -5– / FO-5– | | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|
| | | SWEEP TIME VARI. PRESET | | SWEEP TIME / DIV (RT) | | | (CT) | | |
| | | $\overline{\text{B}}$ | $\overline{\text{A}}$ | $\overline{\text{C}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ | $\overline{\text{C}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ |
| SWEEP TIME VARI. PRESET | 1 | L | L | | | | | | |
| | 2 | L | H | | | | | | |
| | 3 | H | L | | | | | | |
| | CAL | H | H | | | | | | |
| SWEEP TIME/DIV | X-Y | | | H | H | H | L | L | L |
| | .5s | | | L | L | L | L | L | H |
| | .2s | | | L | L | H | L | L | H |
| | .1s | | | L | H | L | L | L | H |
| | 50ms | | | L | H | H | L | H | L |
| | 20ms | | | H | L | L | L | H | L |
| | 10ms | | | H | L | H | L | H | L |
| | 5ms | | | L | L | L | L | H | H |
| | 2ms | | | L | L | H | L | H | H |
| | 1ms | | | L | H | L | L | H | H |
| | .5ms | | | L | H | H | H | L | L |
| | .2ms | | | H | L | L | H | L | L |
| | .1ms | | | H | L | H | H | L | L |
| | 50μs | | | L | L | L | H | L | H |
| | 20μs | | | L | L | H | H | L | H |
| | 10μs | | | L | H | L | H | L | H |
| | 5μs | | | L | H | H | H | H | L |
| | 2μs | | | H | L | L | H | H | L |
| | 1μs | | | H | L | H | H | H | L |
| | .5μs | | | H | H | L | H | H | H |
| | .2μs | | | H | H | H | H | H | H |

**6**

| FI -6– / FO-6– | | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|
| | | ×5 MAG | | | FIX | VIDEO POLARITY | | SLOPE | |
| | | ×5MAG | | | FIX | $\overline{\text{TVH}}$ | $\overline{\text{TV(+)}}$ | $\overline{\text{CH2(−)}}$ | $\overline{\text{CH1(−)}}$ |
| ×5MAG | ON | H | | | | | | | |
| | OFF | L | | | | | | | |
| FIX | ON | | | | H | | | | |
| | OFF | | | | L | | | | |
| VIDEO POLARITY | LINE + | | | | | L | L | | |
| | LINE − | | | | | L | H | | |
| | FRAME + | | | | | H | L | | |
| | FRAME − | | | | | H | H | | |
| SLOPE | CH1/CH2 +/+ | | | | | | | H | H |
| | −/+ | | | | | | | L | H |
| | +/− | | | | | | | H | L |
| | −/− | | | | | | | L | L |

**7**

| FI -7– / FO-7– | | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|
| | | EXT. TRIG* | | SOURCE | | | COUPLING | | |
| | | $\overline{\text{B}}$ | $\overline{\text{A}}$ | $\overline{\text{C}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ | $\overline{\text{C}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ |
| EXT* TRIG | OFF | H | H | | | | | | |
| | 1 | H | L | | | | | | |
| | 2 | L | H | | | | | | |
| | 3 | L | L | | | | | | |
| SOURCE | V. MODE | | | H | H | H | | | |
| | CH1 | | | H | H | L | | | |
| | CH2 | | | H | L | H | | | |
| | LINE | | | H | L | L | | | |
| | EXT. | | | L | H | H | | | |
| COUPLING | AC | | | | | | H | H | H |
| | LF Rej | | | | | | H | H | L |
| | HF Rej | | | | | | H | L | H |
| | DC | | | | | | H | L | L |
| | VIDEO | | | | | | L | H | H |

*For Using Probe Selector.

**8**

(For using probe selector)

| FI -8- / FO-8- | | | 7 | 6 | 5 |
|---|---|---|---|---|---|
| | | | CH2 INPU | | |
| | | | $\overline{\text{D}}$ | $\overline{\text{C}}$ | $\overline{\text{B}}$ |
| CH2 INPUT | | 1 | L | L | L |
| | | 2 | L | L | L |
| | | 3 | L | L | H |
| | | 4 | L | L | H |
| | | 5 | L | H | L |
| | ONLY RU-1723 | 6 | L | H | L |
| | | 7 | L | H | H |
| | | 8 | L | H | H |
| | | 9 | H | L | L |
| | | 10 | H | L | L |
| CH1 INPUT | | 1 | | | |
| | | 2 | | | |
| | | 3 | | | |
| | | 4 | | | |
| | | 5 | | | |
| | ONLY RU-1723 | 6 | | | |
| | | 7 | | | |
| | | 8 | | | |
| | | 9 | | | |
| | | 10 | | | |

# TROUBLESHOOTING

| | | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|
| | IV | | CH1<br>GAIN PRESET | | |
| | $\overline{\text{A}}$ | C | B | A | |
| | | | | | |
| | | | | | |
| | L | | | | |
| | H | | | | |
| | H | | | | |
| | L | | | | |
| | H | | | | |
| | H | | | | |
| | L | | | | |
| | H | | | | |
| | H | | | | |
| | L | | | | |
| | H | | | | |
| | | L | L | L | |
| | | L | L | H | |
| | | L | H | L | |
| | | L | H | H | |
| | | H | L | L | |

**2**

| FI-2—<br>FO-2— | | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|
| | | CH2<br>AC/DC | CH2<br>VOLTS / DIV | | | | CH2<br>GAIN PRESET | | |
| | | $\overline{\text{DC}}$ | $\overline{\text{1/100}}$ | $\overline{\text{1/10}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ | C | B | A |
| CH2<br>AC-GND-DC | AC | H | | | | | | | |
| | DC | L | | | | | | | |
| CH2<br>VOLTS/DIV | 5V | | L | L | H | L | | | |
| | 2V | | L | L | L | H | | | |
| | 1V | | L | H | H | H | | | |
| | 0.5V | | L | H | H | L | | | |
| | 0.2V | | L | H | L | H | | | |
| | 0.1V | | H | L | H | H | | | |
| | 50mV | | H | L | H | L | | | |
| | 20mV | | H | L | L | H | | | |
| | 10mV | | H | H | H | H | | | |
| | 5mV | | H | H | H | L | | | |
| | 2mV | | H | H | L | H | | | |
| CH2<br>GAIN VARIABLE<br>PRESET | 1 | | | | | | L | L | L |
| | 2 | | | | | | L | L | H |
| | 3 | | | | | | L | H | L |
| | 4 | | | | | | L | H | H |
| | CAL | | | | | | H | L | L |

**3**

| FI-3—<br>FO-3— | | | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | MODE | | | | | | | |
| | | | | $\overline{\text{INV}}$ | $\overline{\text{ADD}}$ | $\overline{\text{CHOP}}$ | $\overline{\text{ALT}}$ | $\overline{\text{CH2}}$ | $\overline{\text{CH1}}$ | SEP |
| MODE | CH2<br>INV | OFF | | H | | | | | | |
| | | ON | | L | | | | | | |
| | CH1 | | | | H | H | H | H | L | |
| | CH2 | | | | H | H | H | L | H | |
| | ALT | | | | H | H | L | H | H | |
| | CHOP | | | | H | L | H | H | H | |
| | ADD | | | | L | H | H | H | H | |
| | SEP | OFF | | | | | | | | L |
| | | ON | | | | | | | | H |

**4**

| FI-4—<br>FO-4— | | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | CH2 POSITION<br>PRESET | | | CH1 POSITION<br>PRESET | | |
| | | | | $\overline{\text{C}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ | $\overline{\text{C}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ |
| CH2<br>POSITION<br>PRESET | 1 | | | H | H | L | | | |
| | 2 | | | H | L | H | | | |
| | 3 | | | H | L | L | | | |
| | 4 | | | L | H | H | | | |
| | 5 | | | L | H | L | | | |
| CH1<br>POSITION<br>PRESET | 1 | | | | | | H | H | L |
| | 2 | | | | | | H | L | H |
| | 3 | | | | | | H | L | L |
| | 4 | | | | | | L | H | H |
| | 5 | | | | | | L | H | L |

| 3 | 2 | 1 | 0 |
|---|---|---|---|
| VIDEO<br>POLARITY | | SLOPE | |
| $\overline{\text{TVH}}$ | $\overline{\text{TV(+)}}$ | $\overline{\text{CH2(−)}}$ | $\overline{\text{CH1(−)}}$ |
| | | | |
| L | L | | |
| L | H | | |
| H | L | | |
| H | H | | |
| | | H | H |
| | | L | H |
| | | H | L |
| | | L | L |

**7**

| FI-7—<br>FO-7— | | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|
| | | EXT. TRIG* | | SOURCE | | | COUPLING | | |
| | | $\overline{\text{B}}$ | $\overline{\text{A}}$ | $\overline{\text{C}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ | $\overline{\text{C}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ |
| EXT*<br>TRIG | OFF | H | H | | | | | | |
| | 1 | H | L | | | | | | |
| | 2 | L | H | | | | | | |
| | 3 | L | L | | | | | | |
| SOURCE | V. MODE | | | H | H | H | | | |
| | CH1 | | | H | H | L | | | |
| | CH2 | | | H | L | H | | | |
| | LINE | | | H | L | L | | | |
| | EXT. | | | L | H | H | | | |
| COUPLING | AC | | | | | | H | H | H |
| | LF Rej | | | | | | H | H | L |
| | HF Rej | | | | | | H | L | H |
| | DC | | | | | | H | L | L |
| | VIDEO | | | | | | L | H | H |

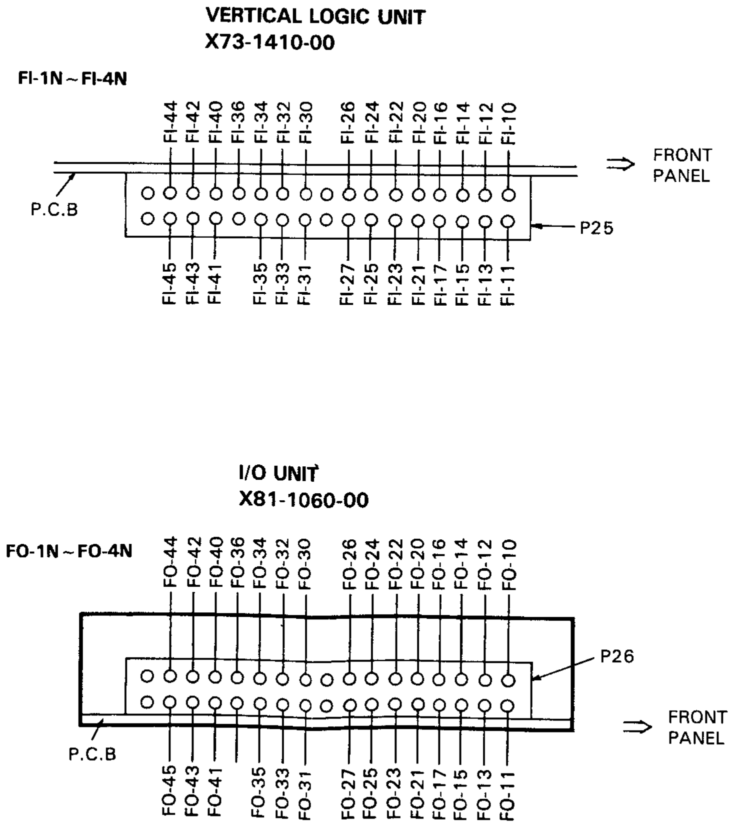
*For Using Probe Selector.

**8**

(For using probe selector)

| FI-8—<br>FO-8— | | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|
| | | CH2 INPUT | | | | CH1 INPUT | | | |
| | | $\overline{\text{D}}$ | $\overline{\text{C}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ | $\overline{\text{D}}$ | $\overline{\text{C}}$ | $\overline{\text{B}}$ | $\overline{\text{A}}$ |
| CH2<br>INPUT | 1 | L | L | L | L | | | | |
| | 2 | L | L | L | H | | | | |
| | 3 | L | L | H | L | | | | |
| | 4 | L | L | H | H | | | | |
| | 5 | L | H | L | L | | | | |
| ONLY<br>RU-1723 | 6 | L | H | L | H | | | | |
| | 7 | L | H | H | L | | | | |
| | 8 | L | H | H | H | | | | |
| | 9 | H | L | L | L | | | | |
| | 10 | H | L | L | H | | | | |
| CH1<br>INPUT | 1 | | | | | L | L | L | L |
| | 2 | | | | | L | L | L | H |
| | 3 | | | | | L | L | H | L |
| | 4 | | | | | L | L | H | H |
| | 5 | | | | | L | H | L | L |
| ONLY<br>RU-1723 | 6 | | | | | L | H | L | H |
| | 7 | | | | | L | H | H | L |
| | 8 | | | | | L | H | H | H |
| | 9 | | | | | H | L | L | L |
| | 10 | | | | | H | L | L | H |

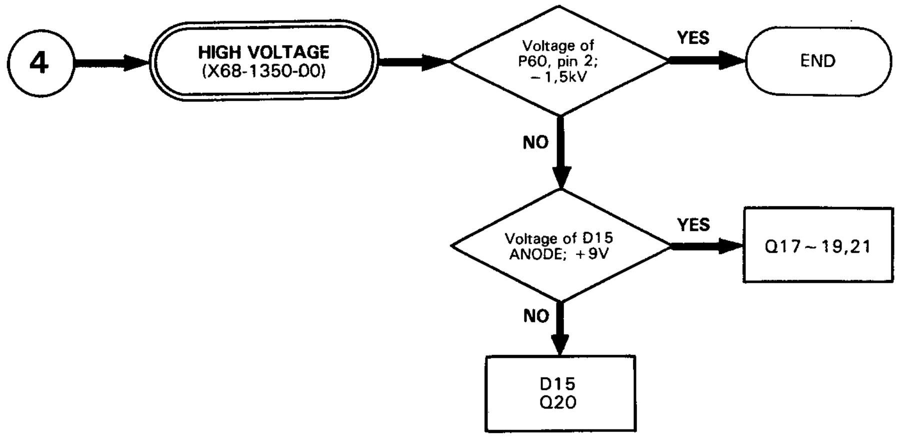
**Fig. 9-2 Location of Test Point**

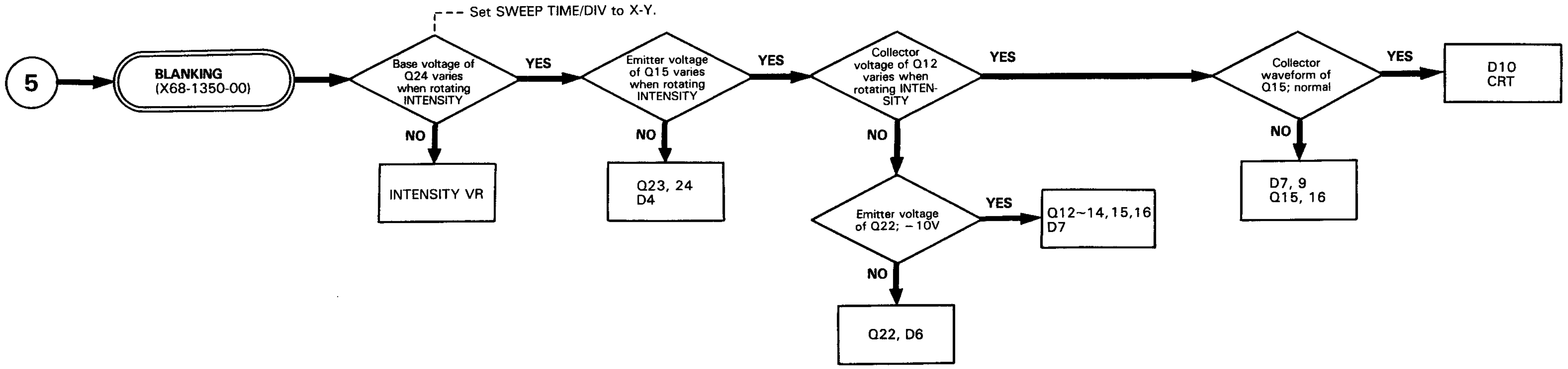

VERTICAL LOGIC UNIT
X73-1410-00

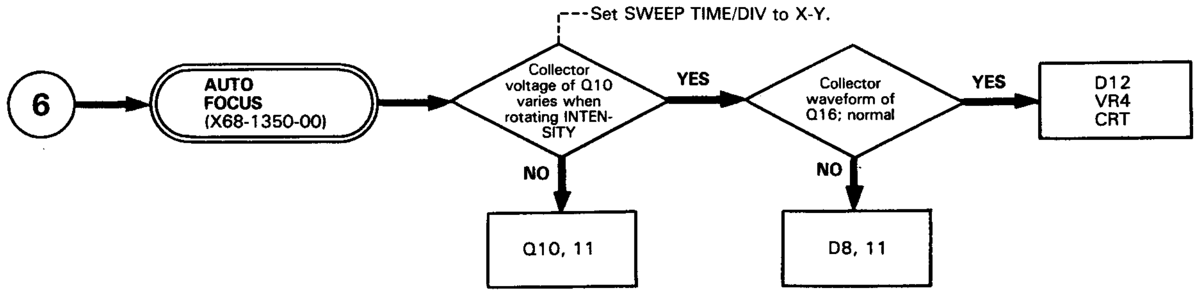
I/O UNIT
X81-1060-00

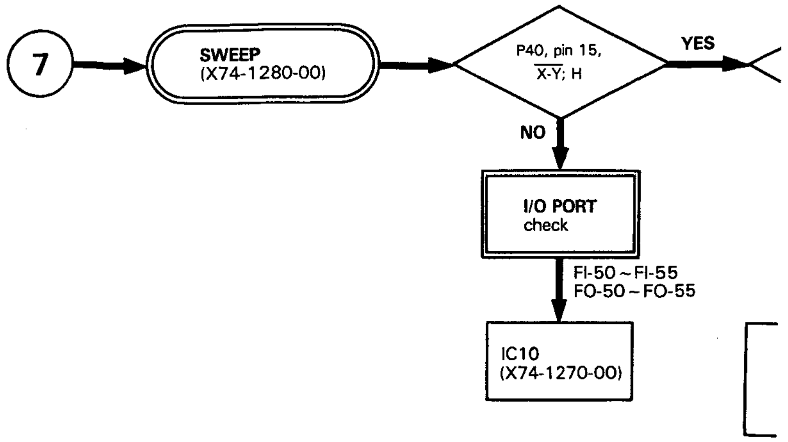
FI-1N ~ FI-4N
FI-44
FI-42
FI-40
FI-36
FI-34
FI-32
FI-30
FI-26
FI-24
FI-22
FI-20
FI-16
FI-14
FI-12
FI-10
FRONT PANEL
P.C.B
P25
FI-45
FI-43
FI-41
FI-35
FI-33
FI-31
FI-27
FI-25
FI-23
FI-21
FI-17
FI-15
FI-13
FI-11
FO-1N ~ FO-4N
FO-44
FO-42
FO-40
FO-36
FO-34
FO-32
FO-30
FO-26
FO-24
FO-22
FO-20
FO-16
FO-14
FO-12
FO-10
P26
FRONT PANEL
P.C.B
FO-45
FO-43
FO-41
FO-35
FO-33
FO-31
FO-27
FO-25
FO-23
FO-21
FO-17
FO-15
FO-13
FO-11

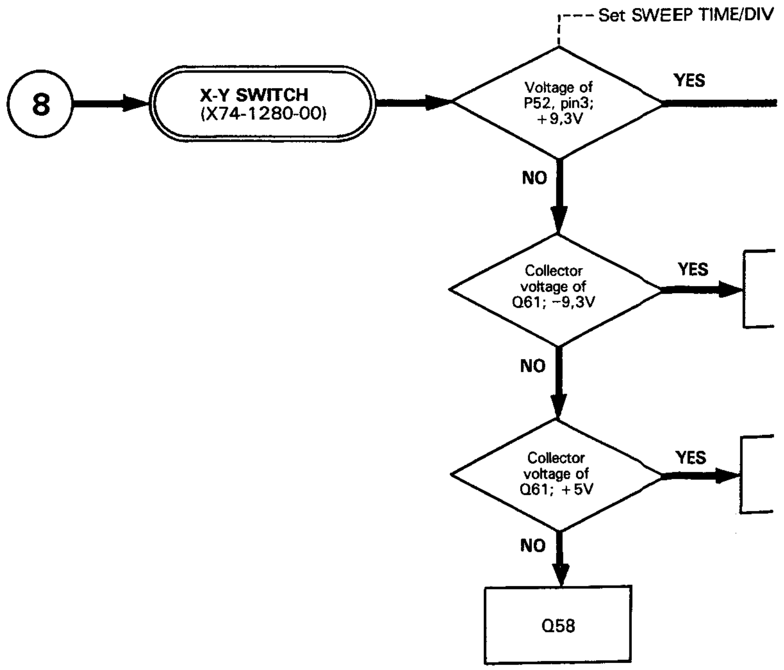
# TROUBLESHOOTING

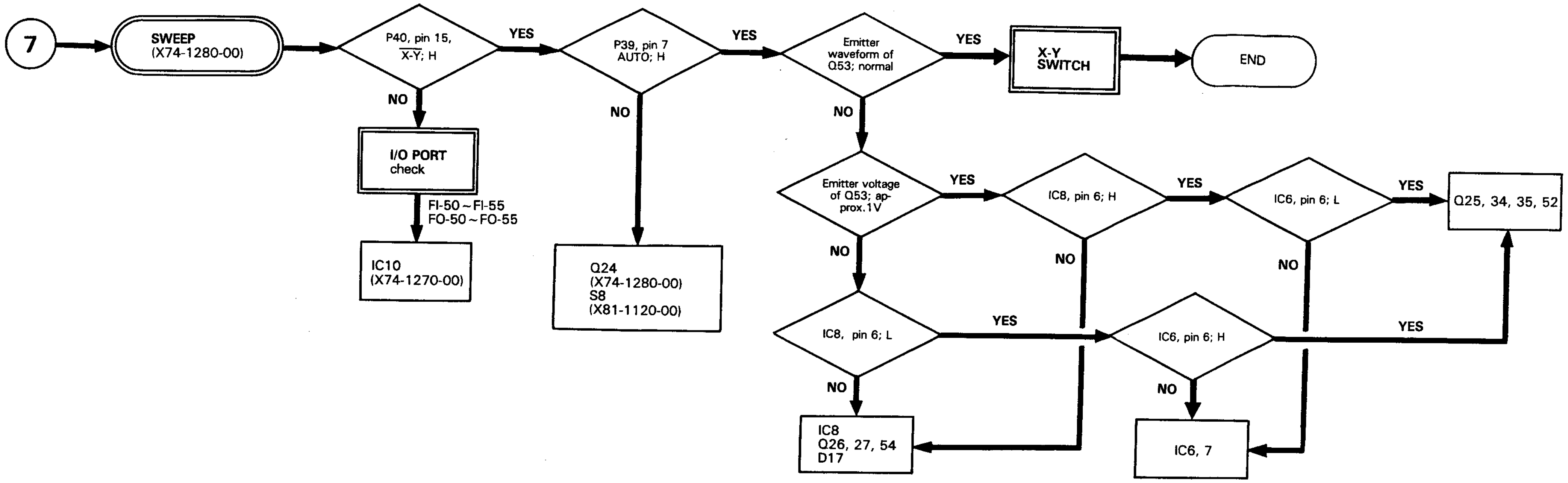

4
HIGH VOLTAGE (X68-1350-00)
Voltage of P60, pin 2; −1,5kV
YES
END
NO
Voltage of D15 ANODE; +9V
YES
Q17~19,21
NO
D15
Q20

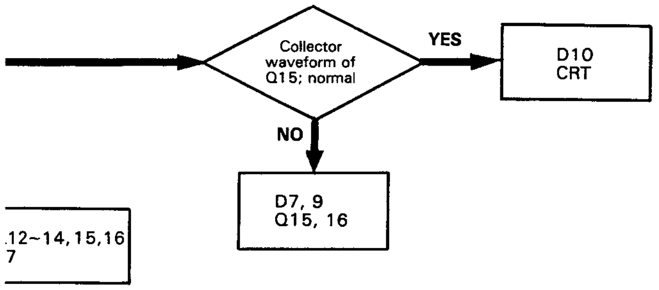

5
BLANKING (X68-1350-00)
Set SWEEP TIME/DIV to X-Y.
Base voltage of Q24 varies when rotating INTENSITY
YES
NO
INTENSITY VR
Emitter voltage of Q15 varies when rotating INTENSITY
YES
NO
Q23, 24
D4
Collector voltage of Q12 varies when rotating INTENSITY
YES
NO
Emitter voltage of Q22; −10V
YES
Q12~14,15,16
D7
NO
Q22, D6
Collector waveform of Q15; normal
YES
D10
CRT
NO
D7, 9
Q15, 16

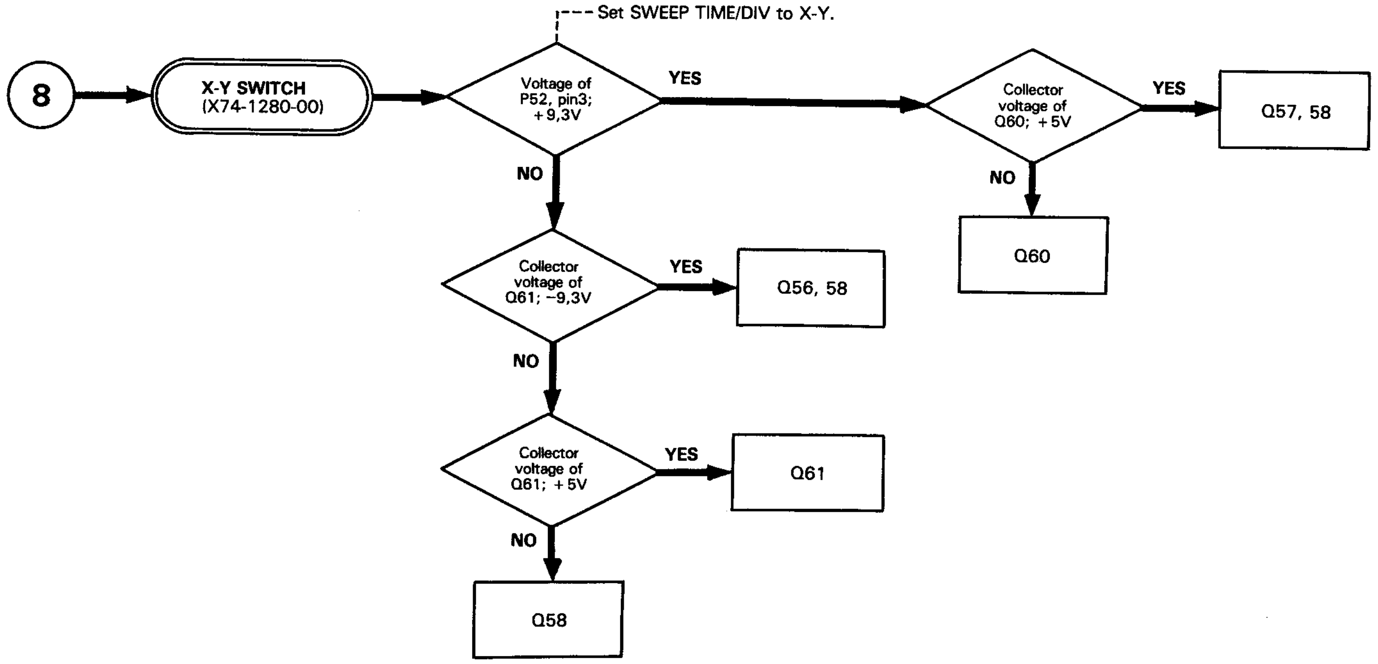

6
AUTO FOCUS (X68-1350-00)
Set SWEEP TIME/DIV to X-Y.
Collector voltage of Q10 varies when rotating INTENSITY
YES
NO
Q10, 11
Collector waveform of Q16; normal
YES
D12
VR4
CRT
NO
D8, 11


7
SWEEP (X74-1280-00)
P40, pin 15, X-Y; H
YES
NO
I/O PORT check
FI-50~FI-55
FO-50~FO-55
IC10
(X74-1270-00)

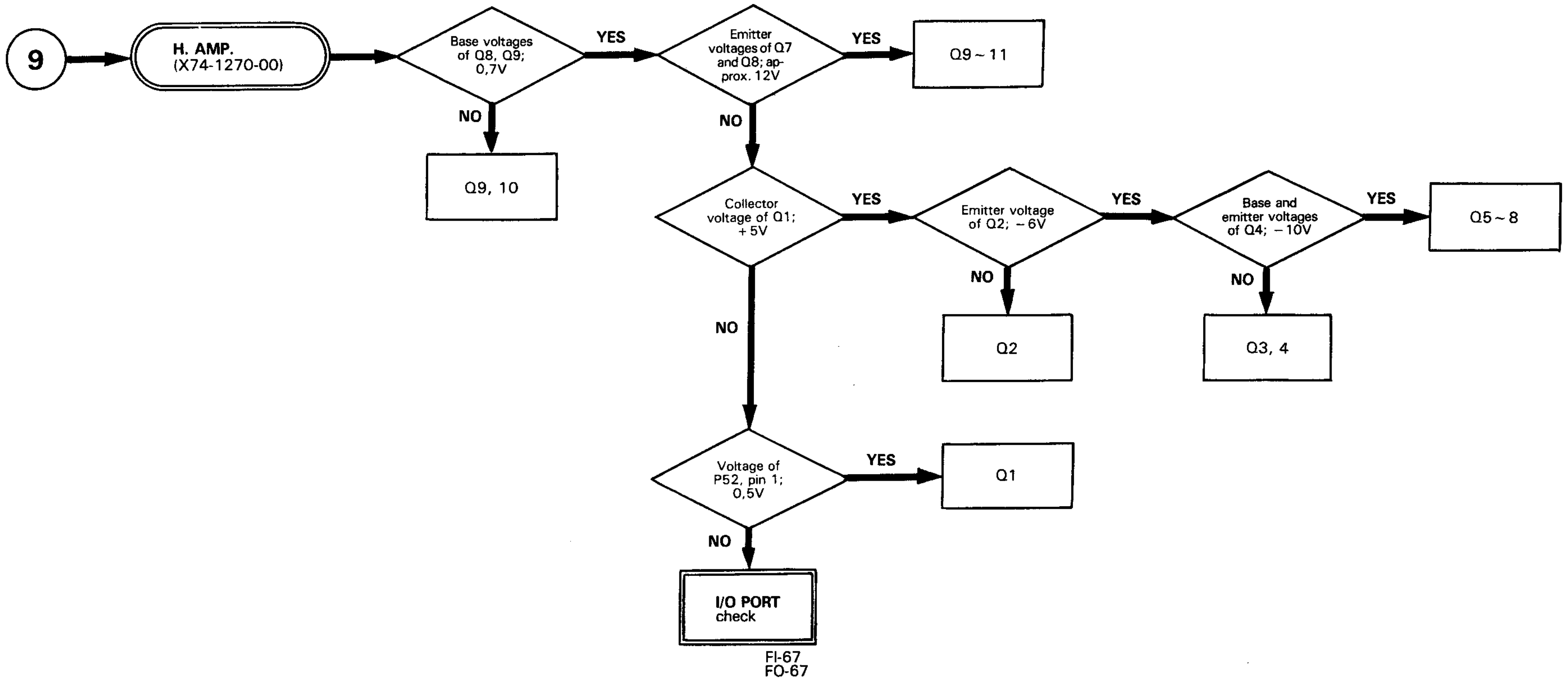

8
X-Y SWITCH (X74-1280-00)
Set SWEEP TIME/DIV
Voltage of P52, pin3; +9,3V
YES
NO
Collector voltage of Q61; −9,3V
YES
NO
Collector voltage of Q61; +5V
YES
NO
Q58

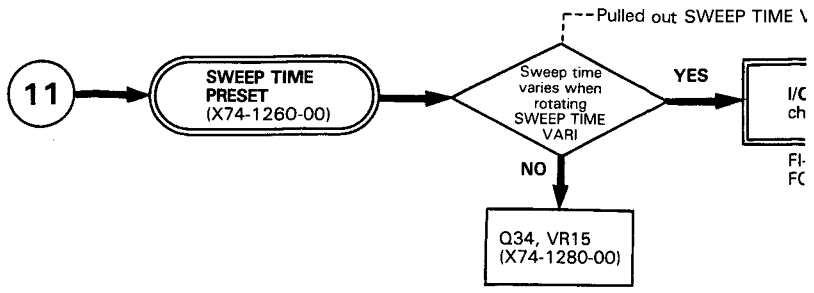

7
SWEEP (X74-1280-00)
P40, pin 15, X-Y; H
YES
NO
I/O PORT check
FI-50～FI-55
FO-50～FO-55
IC10 (X74-1270-00)
P39, pin 7 AUTO; H
YES
NO
Q24 (X74-1280-00) S8 (X81-1120-00)
Emitter waveform of Q53; normal
YES
X-Y SWITCH
END
NO
Emitter voltage of Q53; approx.1V
YES
IC8, pin 6; H
YES
IC6, pin 6; L
YES
Q25, 34, 35, 52
NO
NO
NO
IC8, pin 6; L
YES
IC6, pin 6; H
YES
NO
NO
IC8 Q26, 27, 54 D17
IC6, 7

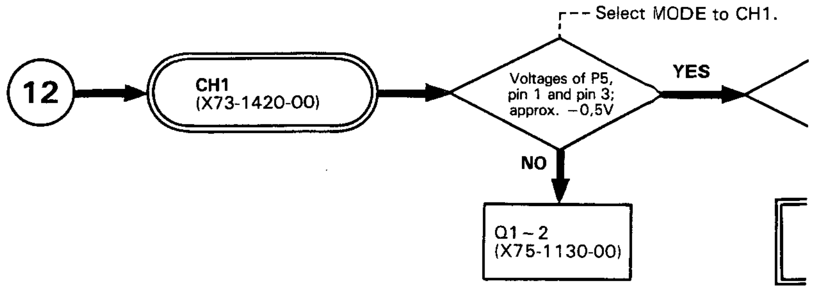

Collector waveform of Q15; normal
YES
D10 CRT
NO
D7, 9 Q15, 16
.12~14, 15, 16
7


8
X-Y SWITCH (X74-1280-00)
Set SWEEP TIME/DIV to X-Y.
Voltage of P52, pin3; +9,3V
YES
Collector voltage of Q60; +5V
YES
Q57, 58
NO
Q60
NO
Collector voltage of Q61; -9,3V
YES
Q56, 58
NO
Collector voltage of Q61; +5V
YES
Q61
NO
Q58

# TROUBLESHOOTING


9
H. AMP.
(X74-1270-00)
Base voltages of Q8, Q9; 0,7V
YES
NO
Q9, 10
Emitter voltages of Q7 and Q8; approx. 12V
YES
Q9 ~ 11
NO
Collector voltage of Q1; +5V
YES
Emitter voltage of Q2; −6V
YES
Base and emitter voltages of Q4; −10V
YES
Q5 ~ 8
NO
Q2
NO
Q3, 4
NO
Voltage of P52, pin 1; 0,5V
YES
Q1
NO
I/O PORT check
FI-67
FO-67


Pulled out SWEEP TIME
11
SWEEP TIME PRESET
(X74-1260-00)
Sweep time varies when rotating SWEEP TIME VARI
YES
I/
ch
FI-
F
NO
Q34, VR15
(X74-1280-00)


Select MODE to CH1.
12
CH1
(X73-1420-00)
Voltages of P5, pin 1 and pin 3; approx. −0,5V
YES
NO
Q1 ~ 2
(X75-1130-00)

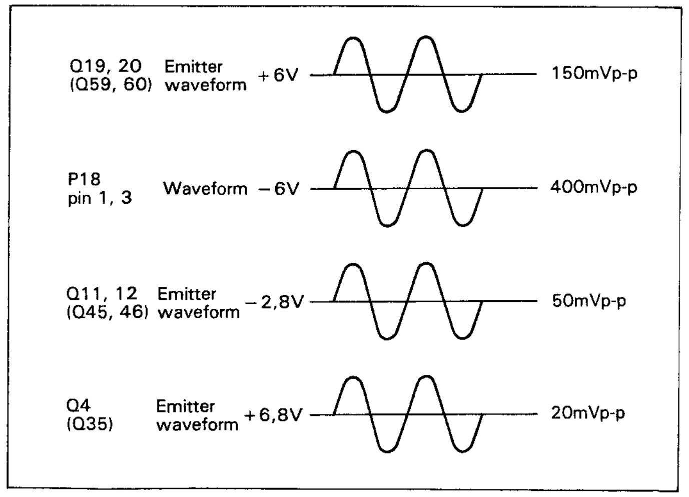
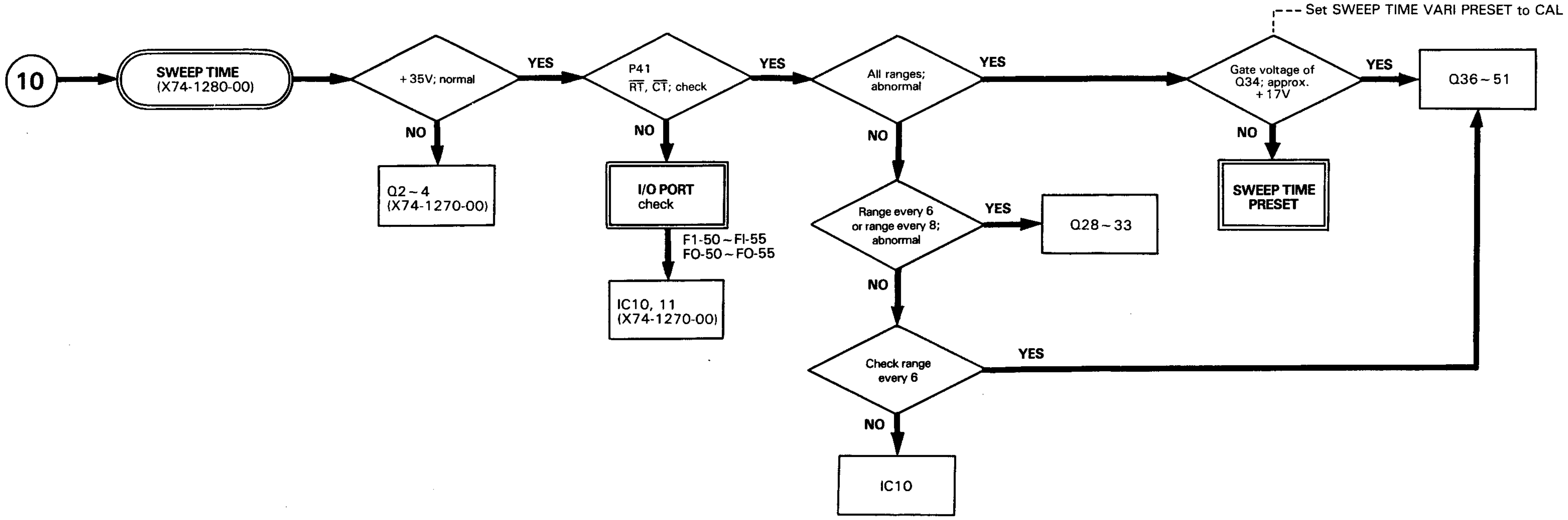

Q19, 20 (Q59, 60) Emitter waveform +6V
150mVp-p
P18 pin 1, 3 Waveform −6V
400mVp-p
Q11, 12 (Q45, 46) Emitter waveform −2,8V
50mVp-p
Q4 (Q35) Emitter waveform +6,8V
20mVp-p

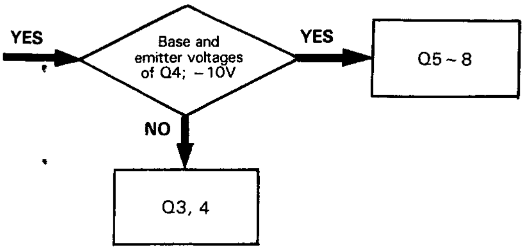
Fig. 9-3

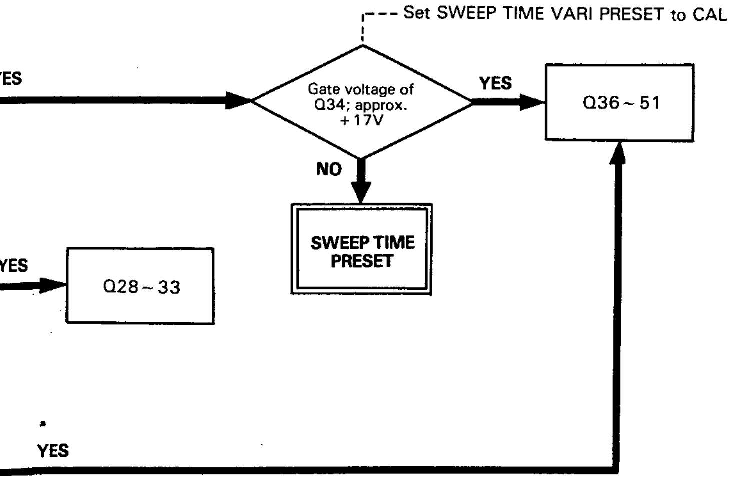

10
SWEEP TIME
(X74-1280-00)
+35V; normal
YES
NO
Q2 ~ 4
(X74-1270-00)
P41 RT, CT; check
YES
NO
I/O PORT check
FI-50 ~ FI-55
FO-50 ~ FO-55
IC10, 11
(X74-1270-00)
All ranges; abnormal
YES
NO
Range every 6 or range every 8; abnormal
YES
Q28 ~ 33
NO
Check range every 6
YES
NO
IC10
Set SWEEP TIME VARI PRESET to CAL
Gate voltage of Q34; approx. +17V
YES
Q36 ~ 51
NO
SWEEP TIME PRESET

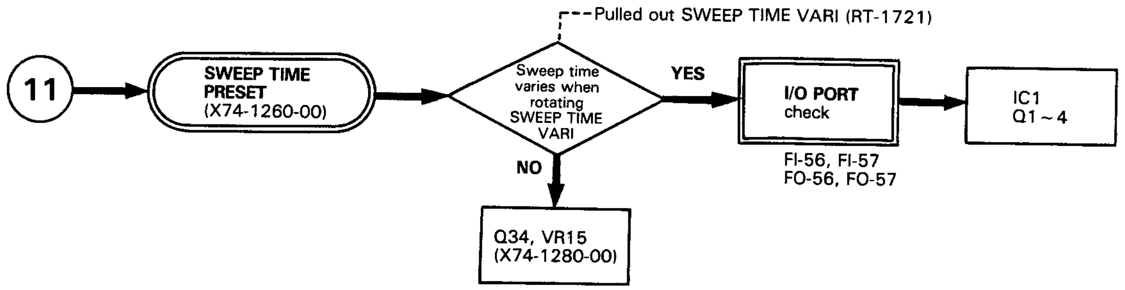
P41

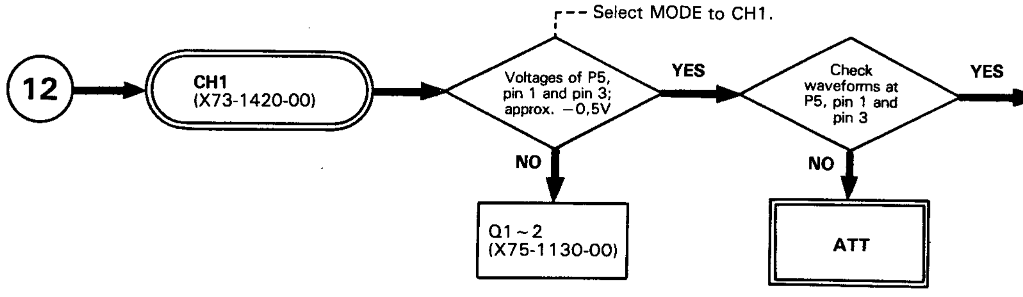
| | $\overline{RT}$ | | | | | | | | $\overline{CT}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| X-Y | H | H | H | H | H | H | H | H | H | H | H | H | H | H | H |
| .5s | L | H | H | H | H | H | H | H | L | H | H | H | H | H | H |
| .2s | H | L | H | H | H | H | H | H | L | H | H | H | H | H | H |
| .1s | H | H | L | H | H | H | H | H | L | H | H | H | H | H | H |
| 50ms | H | H | H | L | H | H | H | H | H | L | H | H | H | H | H |
| 20ms | H | H | H | H | L | H | H | H | H | L | H | H | H | H | H |
| 10ms | H | H | H | H | H | L | H | H | H | L | H | H | H | H | H |

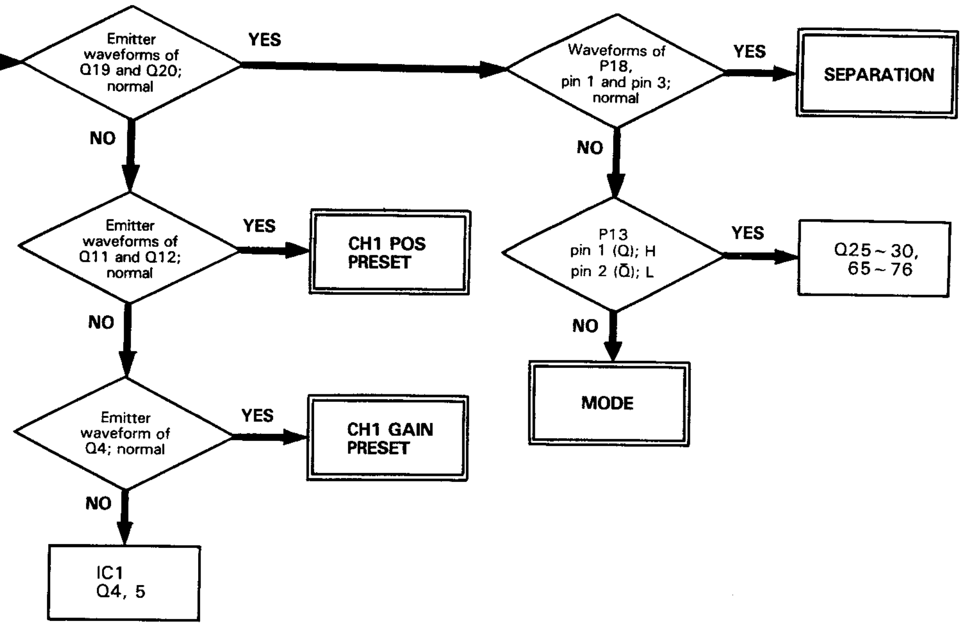
# TROUBLESHOOTING


YES
Base and emitter voltages of Q4; −10V
YES
Q5 ~ 8
NO
Q3, 4


Set SWEEP TIME VARI PRESET to CAL
ES
Gate voltage of Q34; approx. +17V
YES
Q36 ~ 51
NO
SWEEP TIME PRESET
YES
Q28 ~ 33
YES


Pulled out SWEEP TIME VARI (RT-1721)
11
SWEEP TIME PRESET (X74-1260-00)
Sweep time varies when rotating SWEEP TIME VARI
YES
I/O PORT check
FI-56, FI-57
FO-56, FO-57
IC1
Q1 ~ 4
NO
Q34, VR15 (X74-1280-00)


Select MODE to CH1.
12
CH1 (X73-1420-00)
Voltages of P5, pin 1 and pin 3; approx. −0,5V
YES
Check waveforms at P5, pin 1 and pin 3
YES
NO
Q1 ~ 2 (X75-1130-00)
NO
ATT


Emitter waveforms of Q19 and Q20; normal
YES
Waveforms of P18, pin 1 and pin 3; normal
YES
SEPARATION
NO
Emitter waveforms of Q11 and Q12; normal
YES
CH1 POS PRESET
NO
Emitter waveform of Q4; normal
YES
CH1 GAIN PRESET
NO
IC1
Q4, 5
NO
P13 pin 1 (Q); H pin 2 (Q̄); L
YES
Q25 ~ 30, 65 ~ 76
NO
MODE

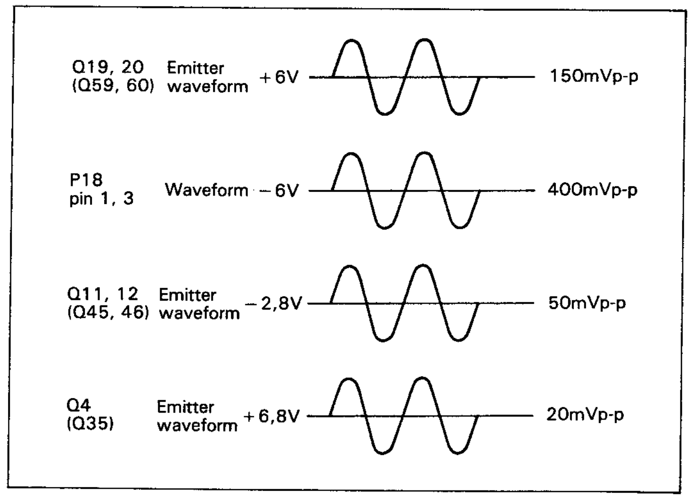

Q19, 20 (Q59, 60) Emitter waveform +6V 150mVp-p
P18 pin 1, 3 Waveform −6V 400mVp-p
Q11, 12 (Q45, 46) Emitter waveform −2,8V 50mVp-p
Q4 (Q35) Emitter waveform +6,8V 20mVp-p

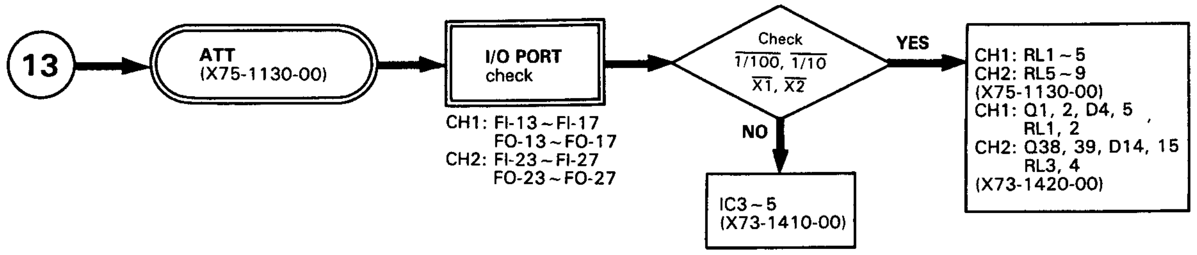
Fig. 9-3

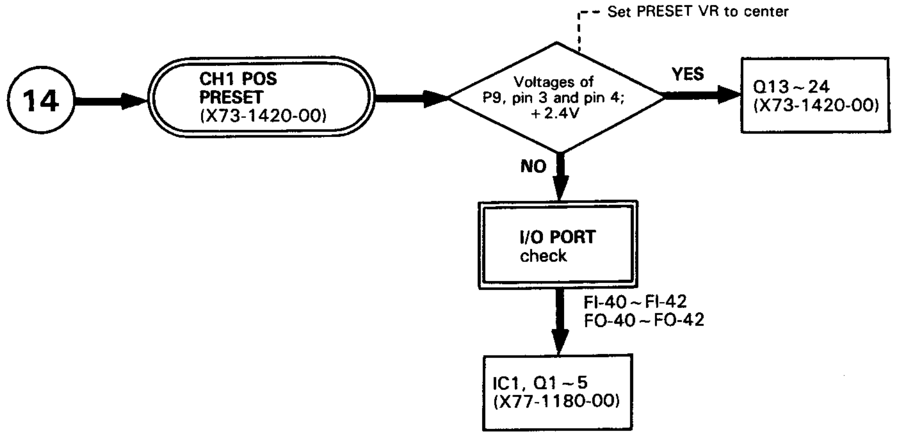
Table 9-3 Sweep Time/Div — $\overline{RT}$, $\overline{CT}$ Truth Table

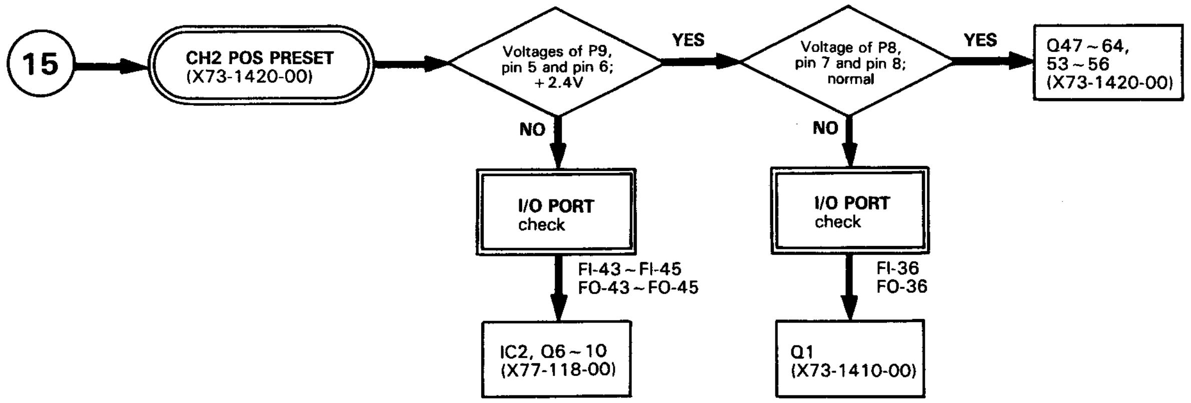
P41

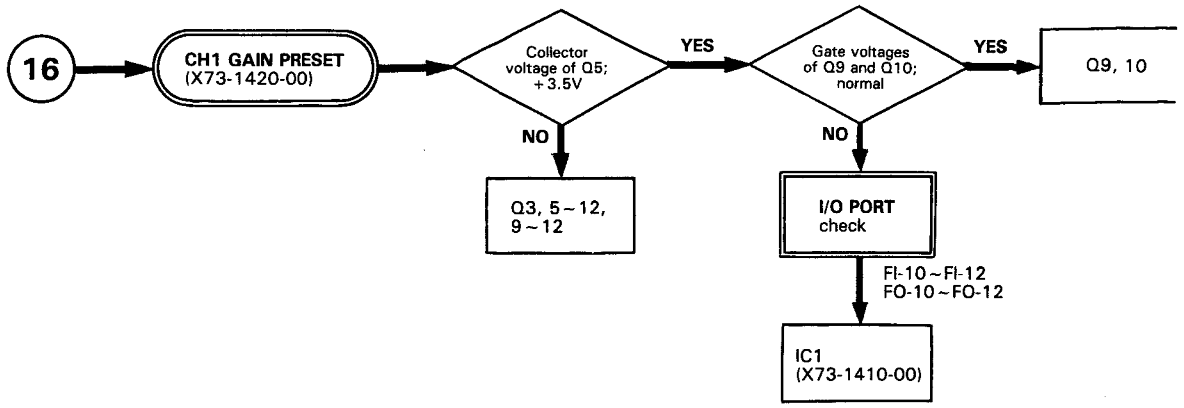
| | $\overline{RT}$ | | | | | | | | $\overline{CT}$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| X-Y | H | H | H | H | H | H | H | H | H | H | H | H | H | H | H |
| .5s | L | H | H | H | H | H | H | H | L | H | H | H | H | H | H |
| .2s | H | L | H | H | H | H | H | H | L | H | H | H | H | H | H |
| .1s | H | H | L | H | H | H | H | H | L | H | H | H | H | H | H |
| 50ms | H | H | H | L | H | H | H | H | H | L | H | H | H | H | H |
| 20ms | H | H | H | H | L | H | H | H | H | L | H | H | H | H | H |
| 10ms | H | H | H | H | H | L | H | H | H | L | H | H | H | H | H |
| 5ms | L | H | H | H | H | H | H | H | H | H | L | H | H | H | H |
| 2ms | H | L | H | H | H | H | H | H | H | H | L | H | H | H | H |
| 1ms | H | H | L | H | H | H | H | H | H | H | L | H | H | H | H |
| .5ms | H | H | H | L | H | H | H | H | H | H | H | L | H | H | H |
| .2ms | H | H | H | H | L | H | H | H | H | H | H | L | H | H | H |
| .1ms | H | H | H | H | H | L | H | H | H | H | H | L | H | H | H |
| 50μs | L | H | H | H | H | H | H | H | H | H | H | H | L | H | H |
| 20μs | H | L | H | H | H | H | H | H | H | H | H | H | L | H | H |
| 10μs | H | H | L | H | H | H | H | H | H | H | H | H | L | H | H |
| 5μs | H | H | H | L | H | H | H | H | H | H | H | H | H | L | H |
| 2μs | H | H | H | H | L | H | H | H | H | H | H | H | H | L | H |
| 1μs | H | H | H | H | H | L | H | H | H | H | H | H | H | L | H |
| .5μs | H | H | H | H | H | H | L | H | H | H | H | H | H | H | L |
| .2μs | H | H | H | H | H | H | H | L | H | H | H | H | H | H | L |

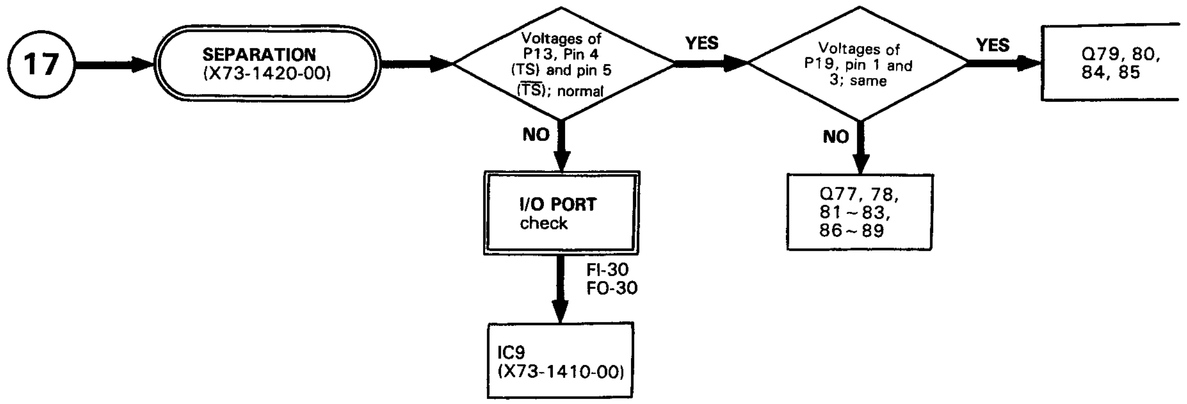
# TROUBLESHOOTING

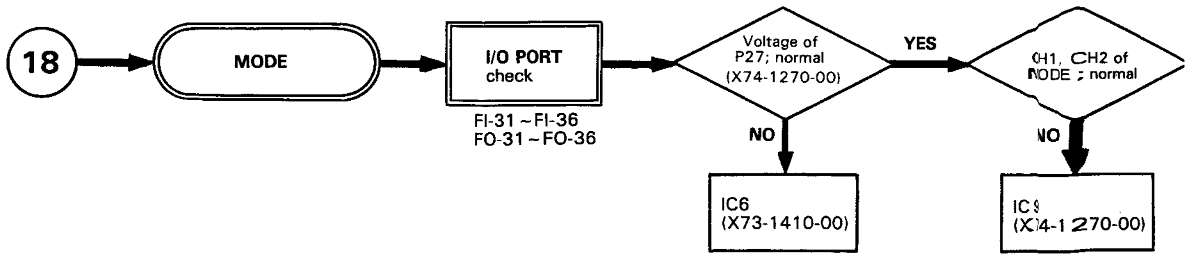

13
ATT
(X75-1130-00)
I/O PORT
check
CH1: FI-13~FI-17
FO-13~FO-17
CH2: FI-23~FI-27
FO-23~FO-27
Check
$\overline{1/100}$, $\overline{1/10}$
$\overline{X1}$, $\overline{X2}$
YES
NO
IC3~5
(X73-1410-00)
CH1: RL1~5
CH2: RL5~9
(X75-1130-00)
CH1: Q1, 2, D4, 5
RL1, 2
CH2: Q38, 39, D14, 15
RL3, 4
(X73-1420-00)

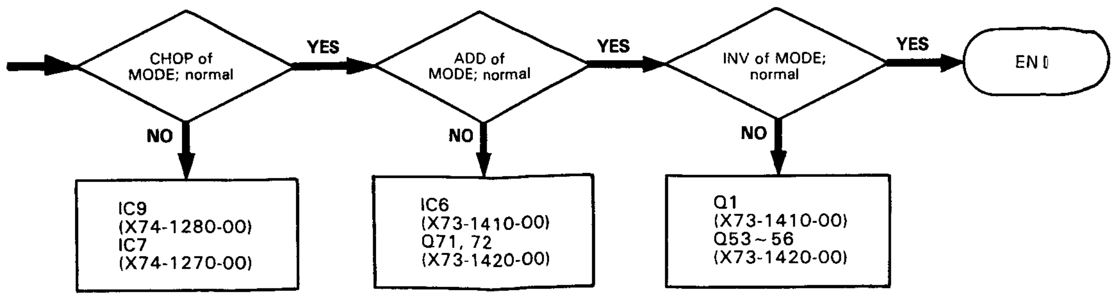

Set PRESET VR to center
14
CH1 POS
PRESET
(X73-1420-00)
Voltages of
P9, pin 3 and pin 4;
+2.4V
YES
Q13~24
(X73-1420-00)
NO
I/O PORT
check
FI-40~FI-42
FO-40~FO-42
IC1, Q1~5
(X77-1180-00)


15
CH2 POS PRESET
(X73-1420-00)
Voltages of P9,
pin 5 and pin 6;
+2.4V
YES
Voltage of P8,
pin 7 and pin 8;
normal
YES
Q47~64,
53~56
(X73-1420-00)
NO
I/O PORT
check
FI-43~FI-45
FO-43~FO-45
IC2, Q6~10
(X77-118-00)
NO
I/O PORT
check
FI-36
FO-36
Q1
(X73-1410-00)

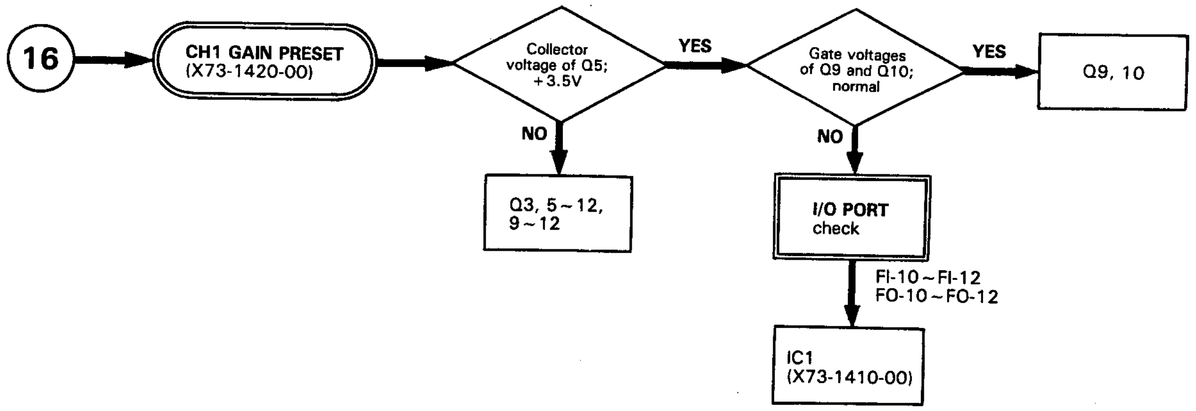

16
CH1 GAIN PRESET
(X73-1420-00)
Collector
voltage of Q5;
+3.5V
YES
Gate voltages
of Q9 and Q10;
normal
YES
Q9, 10
NO
Q3, 5~12,
9~12
NO
I/O PORT
check
FI-10~FI-12
FO-10~FO-12
IC1
(X73-1410-00)

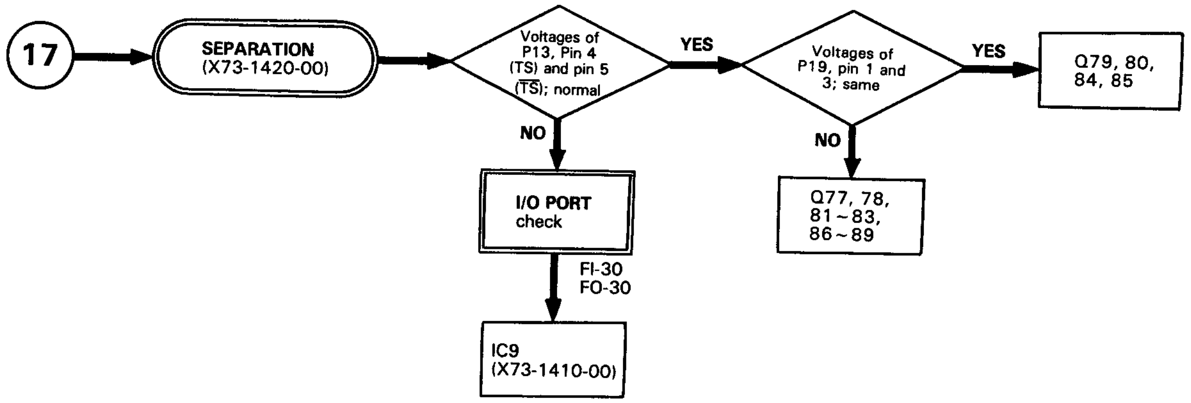

17
SEPARATION
(X73-1420-00)
Voltages of
P13, Pin 4
(TS) and pin 5
($\overline{TS}$); normal
YES
Voltages of
P19, pin 1 and
3; same
YES
Q79, 80,
84, 85
NO
I/O PORT
check
FI-30
FO-30
IC9
(X73-1410-00)
NO
Q77, 78,
81~83,
86~89


18
MODE
I/O PORT
check
FI-31~FI-36
FO-31~FO-36
Voltage of
P27; normal
(X74-1270-00)
YES
CH1, CH2 of
MODE ; normal
NO
IC6
(X73-1410-00)
NO
IC9
(X74-1270-00)


CHOP of
MODE; normal
YES
ADD of
MODE; normal
YES
INV of MODE;
normal
YES
END
NO
IC9
(X74-1280-00)
IC7
(X74-1270-00)
NO
IC6
(X73-1410-00)
Q71, 72
(X73-1420-00)
NO
Q1
(X73-1410-00)
Q53~56
(X73-1420-00)

# TROUBLESHOOTING


16
CH1 GAIN PRESET (X73-1420-00)
Collector voltage of Q5; +3.5V
YES
NO
Gate voltages of Q9 and Q10; normal
YES
NO
Q9, 10
Q3, 5~12, 9~12
I/O PORT check
FI-10~FI-12
FO-10~FO-12
IC1 (X73-1410-00)


17
SEPARATION (X73-1420-00)
Voltages of P13, Pin 4 (TS) and pin 5 (TS); normal
YES
NO
Voltages of P19, pin 1 and 3; same
YES
NO
Q79, 80, 84, 85
I/O PORT check
FI-30
FO-30
IC9 (X73-1410-00)
Q77, 78, 81~83, 86~89

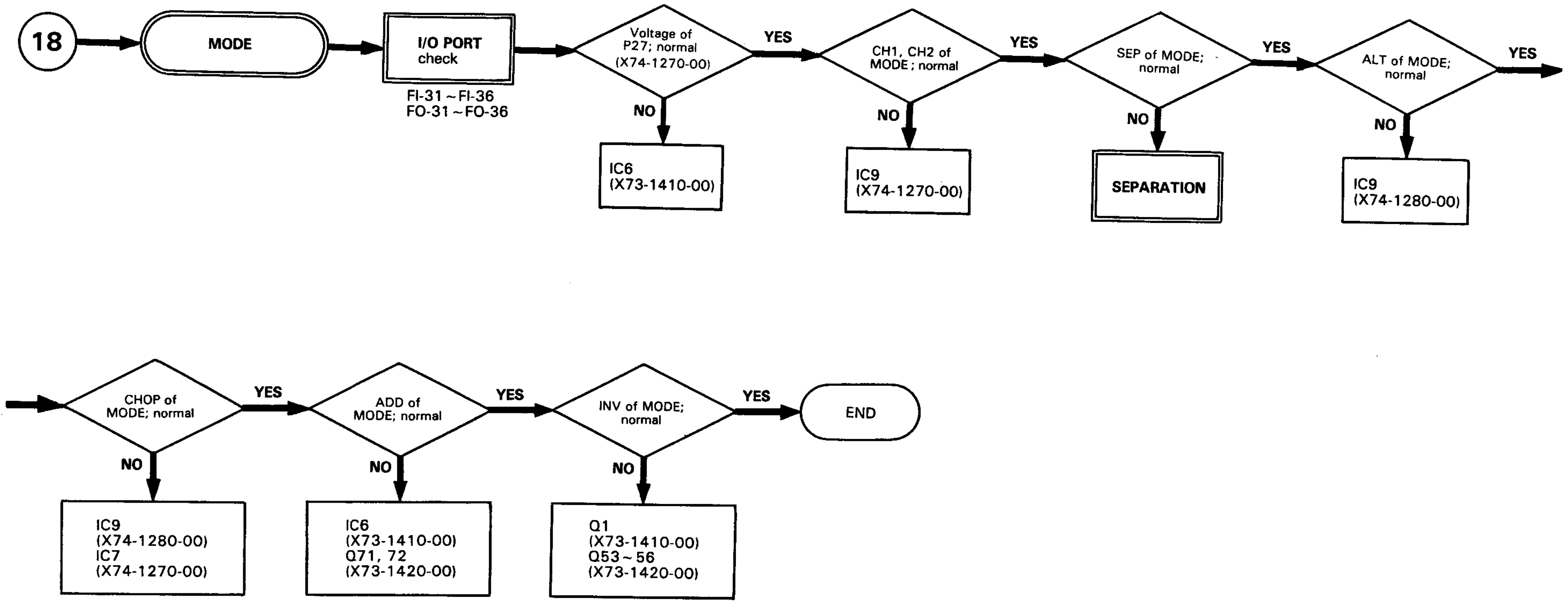
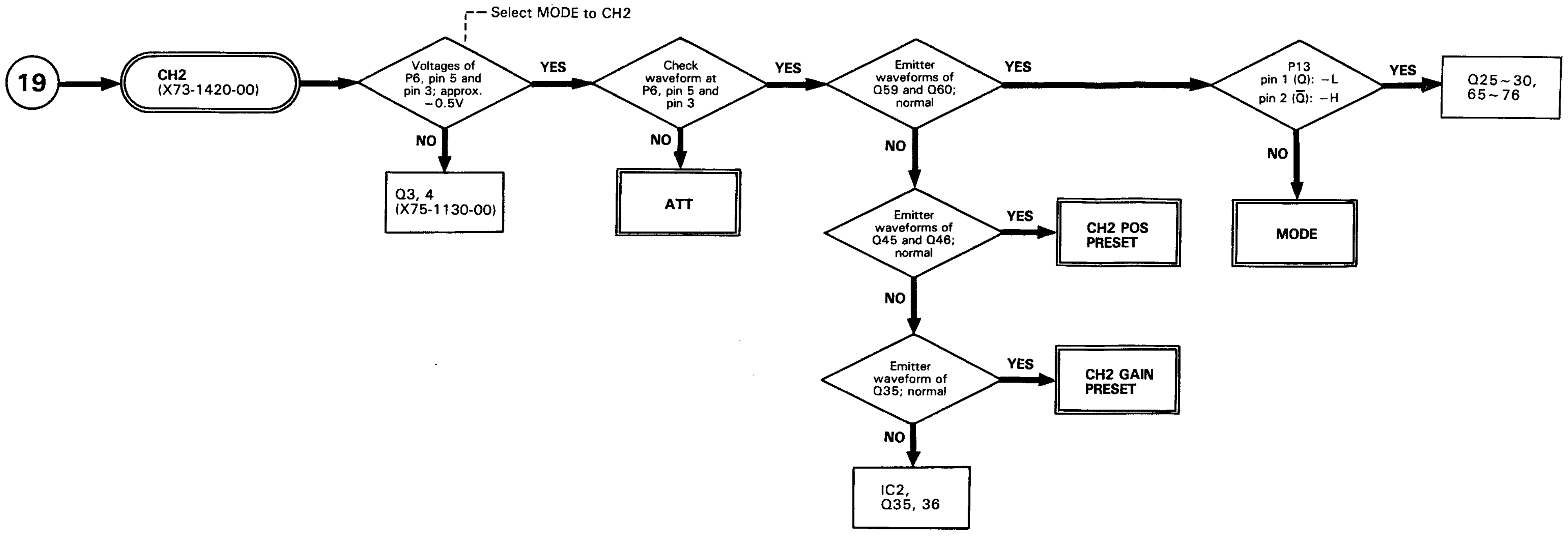
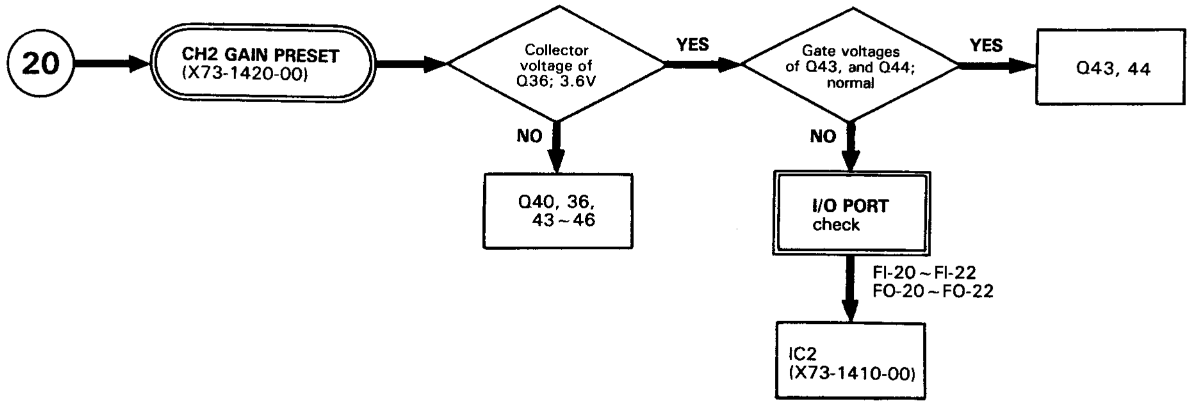

18
MODE
I/O PORT check
FI-31~FI-36
FO-31~FO-36
Voltage of P27; normal (X74-1270-00)
YES
NO
IC6 (X73-1410-00)
CH1, CH2 of MODE; normal
YES
NO
IC9 (X74-1270-00)
SEP of MODE; normal
YES
NO
SEPARATION
ALT of MODE; normal
YES
NO
IC9 (X74-1280-00)
CHOP of MODE; normal
YES
NO
IC9 (X74-1280-00) IC7 (X74-1270-00)
ADD of MODE; normal
YES
NO
IC6 (X73-1410-00) Q71, 72 (X73-1420-00)
INV of MODE; normal
YES
NO
Q1 (X73-1410-00) Q53~56 (X73-1420-00)
END

**Table 9-4 Volts/Div Truth Table**

| | | $\overline{1/100}$* | $\overline{1/10}$* | $\overline{\times 1}$ | $\overline{\times 2}$ |
|---|---|---|---|---|---|
| VOLTS/ DIV | 2mV | H | H | H | H |
| | 5mV | H | H | H | L |
| | 10mV | H | H | L | H |
| | 20mV | H | L | H | H |
| | 50mV | H | L | H | L |
| | .1V | H | L | L | H |
| | .2V | L | H | H | H |
| | .5V | L | H | H | L |
| | 1V | L | H | L | H |
| | 2V | L | L | H | H |
| | 5V | L | L | H | L |

*H: +10V


Select MODE to CH2
19
CH2
(X73-1420-00)
Voltages of P6, pin 5 and pin 3; approx. −0.5V
YES
NO
Q3, 4
(X75-1130-00)
Check waveform at P6, pin 5 and pin 3
YES
NO
ATT
Emitter waveforms of Q59 and Q60; normal
YES
NO
Emitter waveforms of Q45 and Q46; normal
YES
CH2 POS PRESET
NO
Emitter waveform of Q35; normal
YES
CH2 GAIN PRESET
NO
IC2,
Q35, 36
P13
pin 1 (Q): −L
pin 2 (Q̄): −H
YES
Q25~30,
65~76
NO
MODE


20
CH2 GAIN PRESET
(X73-1420-00)
Collector voltage of Q36; 3.6V
YES
NO
Q40, 36,
43~46
Gate voltages of Q43, and Q44; normal
YES
Q43, 44
NO
I/O PORT
check
FI-20~FI-22
FO-20~FO-22
IC2
(X73-1410-00)

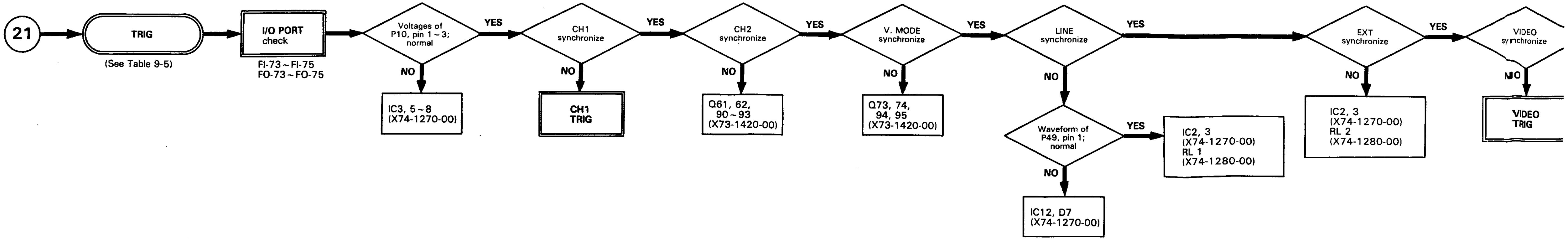

21
TRIG
(See Table 9-5)
I/O PORT
check
FI-73~FI-75
FO-73~FO-75
Voltages of P10, pin 1~3; normal
YES
NO
IC3, 5~8
(X74-1270-00)
CH1 synchronize
YES
NO
CH1
TRIG
CH2 synchronize
YES
NO
Q61, 62,
90~93
(X73-1420-00)
V. MODE synchronize
YES
NO
Q73, 74,
94, 95
(X73-1420-00)
LINE synchronize
YES
NO
Waveform of P49, pin 1; normal
YES
IC2, 3
(X74-1270-00)
RL 1
(X74-1280-00)
NO
IC12, D7
(X74-1270-00)
EXT synchronize
YES
NO
IC2, 3
(X74-1270-00)
RL 2
(X74-1280-00)
VIDEO
synchronize
NO
VIDEO
TRIG

**Table 9-5 Trig**

| P10 / SOURCE | PIN 1<br>CH2 | PI<br>C |
|---|---|---|
| CH1 | H | L |
| CH2 | L | H |
| V. MODE | H | H |
| LINE, EXT | H | H |

**Horizontal Logic Unit (X74-1270-**

# TROUBLESHOOTING

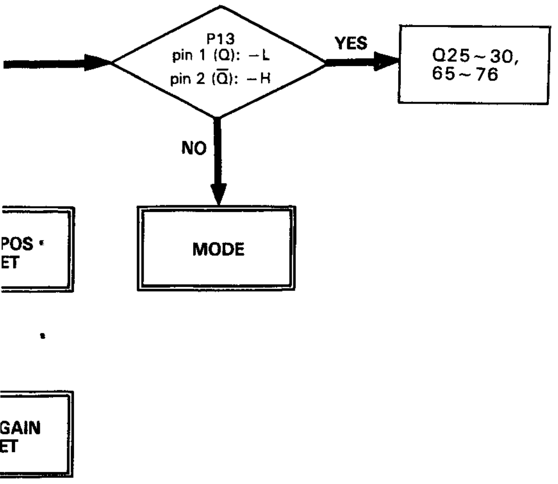
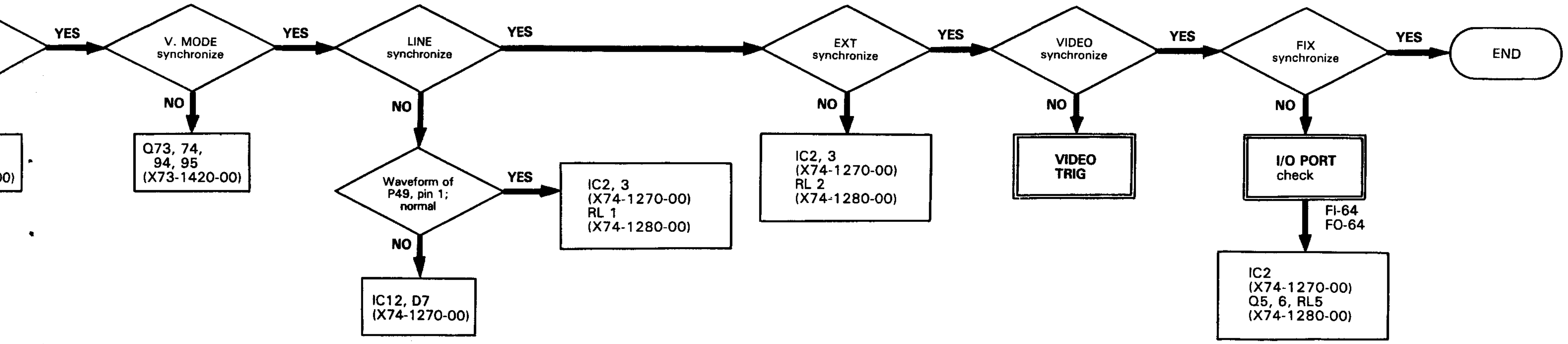
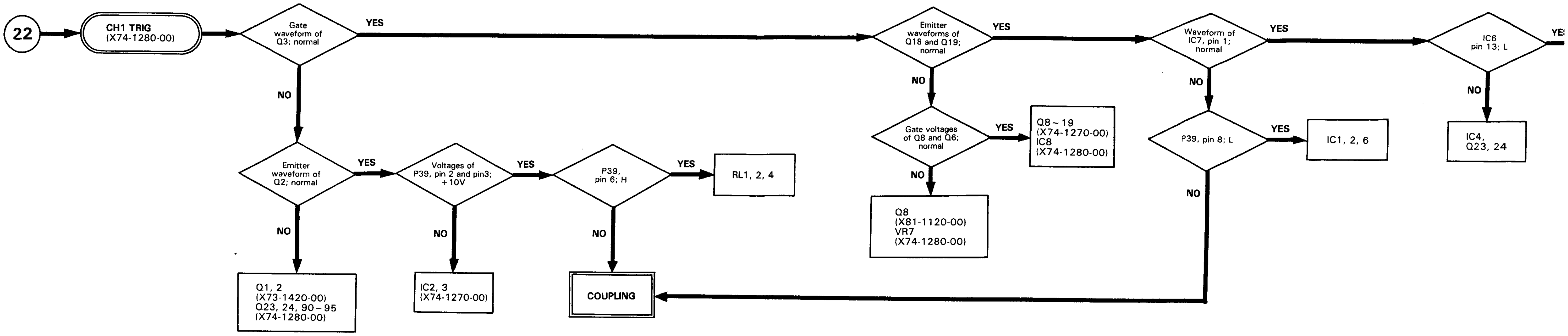

P13
pin 1 (Q): –L
pin 2 ($\overline{Q}$): –H
YES
Q25~30, 65~76
NO
MODE
POS
ET
GAIN
ET

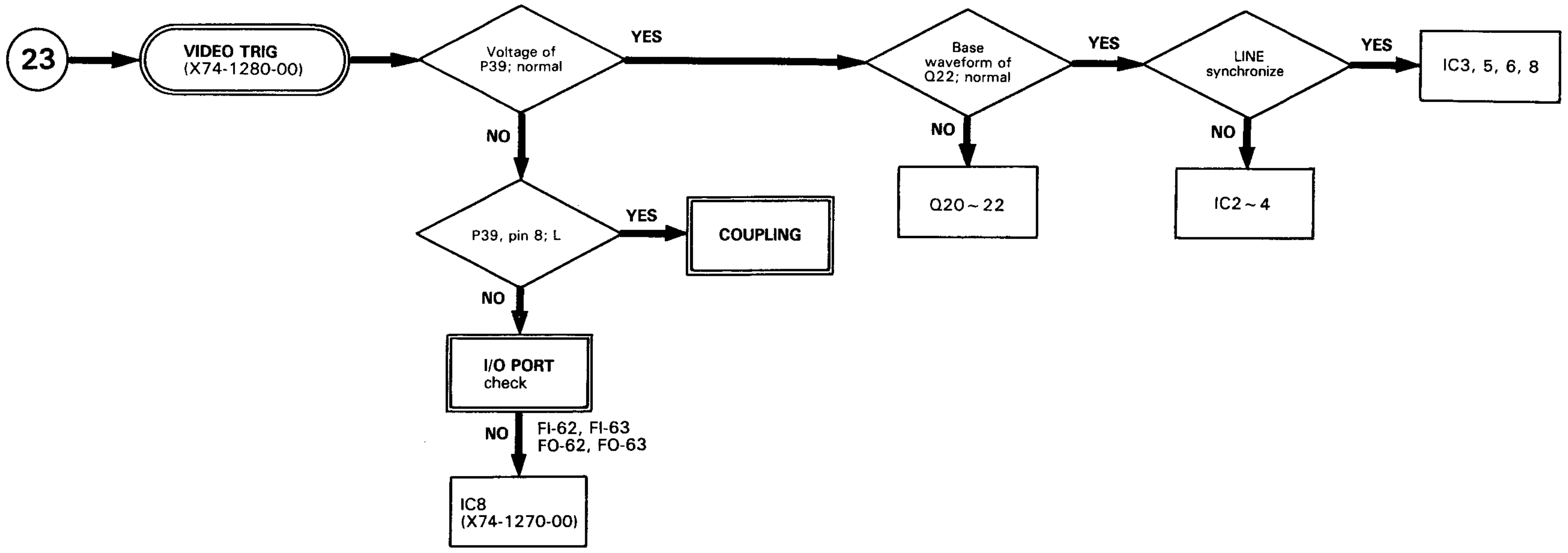
Table 9-5 Trig

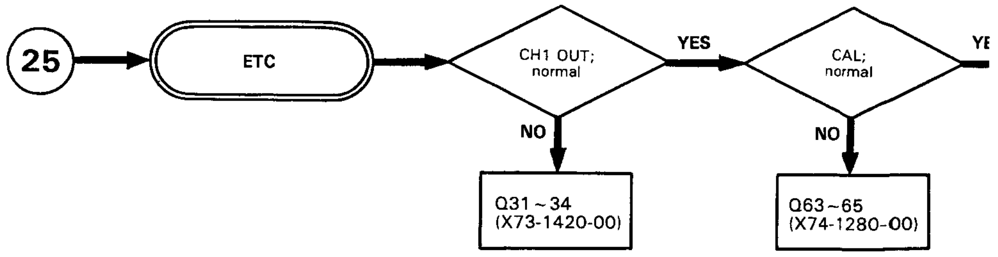
| P10 / SOURCE | PIN 1<br>$\overline{\text{CH2}}$ | PIN 2<br>$\overline{\text{CH1}}$ | PIN 3<br>$\overline{\text{V. MODE}}$ |
|---|---|---|---|
| CH1 | H | L | H |
| CH2 | L | H | H |
| V. MODE | H | H | L |
| LINE, EXT | H | H | H |

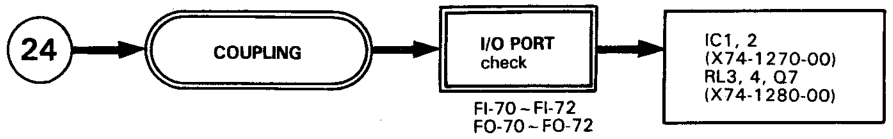
**Horizontal Logic Unit (X74-1270-00)**


YES
V. MODE synchronize
YES
LINE synchronize
YES
EXT synchronize
YES
VIDEO synchronize
YES
FIX synchronize
YES
END
0)
NO
Q73, 74, 94, 95 (X73-1420-00)
NO
Waveform of P49, pin 1; normal
YES
IC2, 3 (X74-1270-00) RL 1 (X74-1280-00)
NO
IC12, D7 (X74-1270-00)
NO
IC2, 3 (X74-1270-00) RL 2 (X74-1280-00)
NO
VIDEO TRIG
NO
I/O PORT check
FI-64
FO-64
IC2 (X74-1270-00) Q5, 6, RL5 (X74-1280-00)


22
CH1 TRIG
(X74-1280-00)
Gate waveform of Q3; normal
YES
NO
Emitter waveform of Q2; normal
YES
NO
Voltages of P39, pin 2 and pin3; +10V
YES
NO
P39, pin 6; H
YES
NO
RL1, 2, 4
Q1, 2
(X73-1420-00)
Q23, 24, 90~95
(X74-1280-00)
IC2, 3
(X74-1270-00)
COUPLING
Emitter waveforms of Q18 and Q19; normal
YES
NO
Gate voltages of Q8 and Q6; normal
YES
NO
Q8~19
(X74-1270-00)
IC8
(X74-1280-00)
Q8
(X81-1120-00)
VR7
(X74-1280-00)
Waveform of IC7, pin 1; normal
YES
NO
P39, pin 8; L
YES
NO
IC1, 2, 6
IC6 pin 13; L
NO
IC4,
Q23, 24


23
VIDEO TRIG
(X74-1280-00)
Voltage of P39; normal
YES
NO
P39, pin 8; L
YES
NO
COUPLING
I/O PORT check
NO
FI-62, FI-63
FO-62, FO-63
IC8
(X74-1270-00)
Base waveform of Q22; normal
YES
NO
Q20~22
LINE synchronize
YES
NO
IC2~4
IC3, 5, 6, 8


25
ETC
CH1 OUT; normal
YES
NO
Q31~34
(X73-1420-00)
CAL; normal
NO
Q63~65
(X74-1280-00)


24
COUPLING
I/O PORT check
FI-70~FI-72
FO-70~FO-72
IC1, 2
(X74-1270-00)
RL3, 4, Q7
(X74-1280-00)

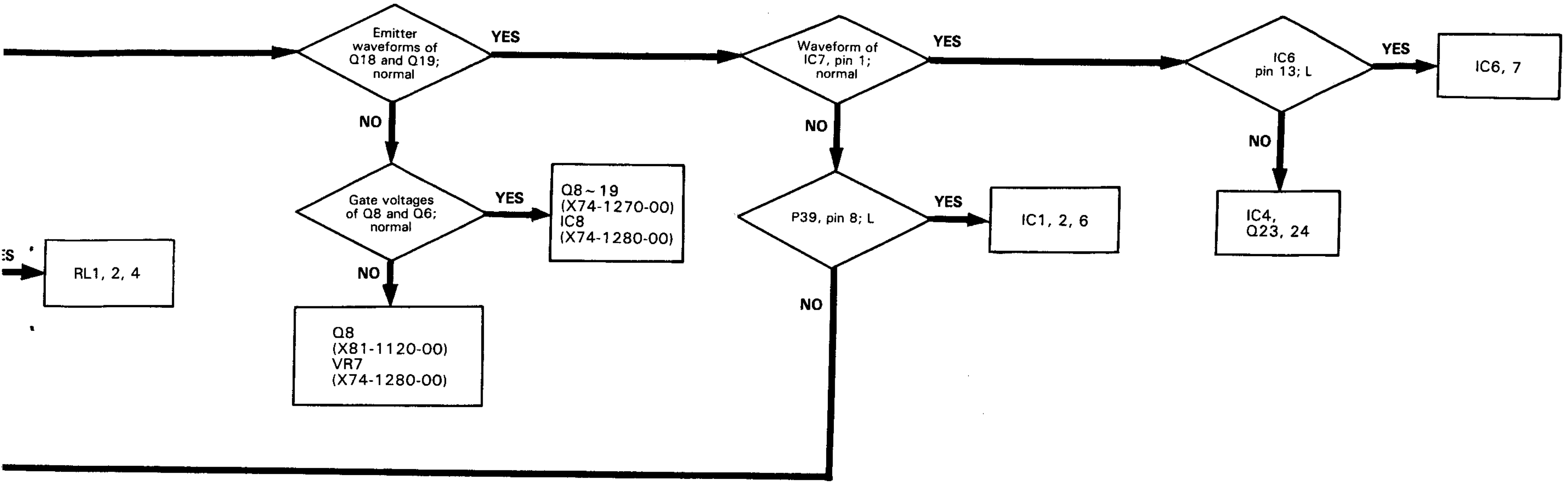
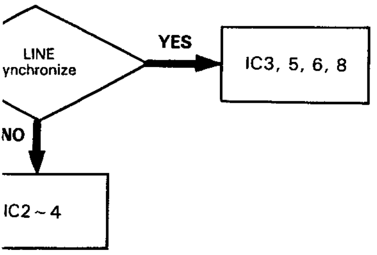
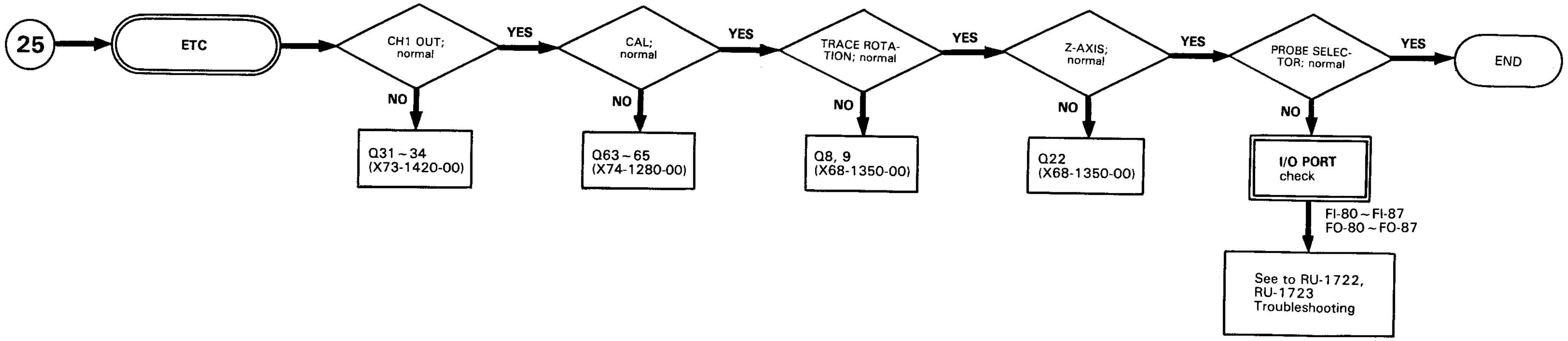

Emitter waveforms of Q18 and Q19; normal
YES
NO
Gate voltages of Q8 and Q6; normal
YES
NO
Q8 ~ 19
(X74-1270-00)
IC8
(X74-1280-00)
Q8
(X81-1120-00)
VR7
(X74-1280-00)
ES
RL1, 2, 4
Waveform of IC7, pin 1; normal
YES
NO
P39, pin 8; L
YES
NO
IC1, 2, 6
IC6 pin 13; L
YES
NO
IC6, 7
IC4,
Q23, 24

Table 9-6 P39 Pin 8 Video trig

| P39 / VIDEO POLARITY | PIN 8 VIDEO | PIN 10 $\overline{\text{TV(+)}}$ | PIN 11 $\overline{\text{TV(−)}}$ | PIN 14 $\overline{\text{TVH}}$ |
|---|---|---|---|---|
| LINE + | H | L | H | L |
| LINE − | H | H | L | L |
| FRAME + | H | L | H | H |
| FRAME − | H | H | L | H |


LINE
ynchronize
YES
IC3, 5, 6, 8
NO
IC2 ~ 4


25
ETC
CH1 OUT; normal
YES
NO
Q31 ~ 34
(X73-1420-00)
CAL; normal
YES
NO
Q63 ~ 65
(X74-1280-00)
TRACE ROTATION; normal
YES
NO
Q8, 9
(X68-1350-00)
Z-AXIS; normal
YES
NO
Q22
(X68-1350-00)
PROBE SELECTOR; normal
YES
NO
END
I/O PORT check
FI-80 ~ FI-87
FO-80 ~ FO-87
See to RU-1722, RU-1723 Troubleshooting

7. Reverse bit shift pattern test
   The same procedures as the above test is performed while shifting to the left. If errors occur, perform HLT at address FC.

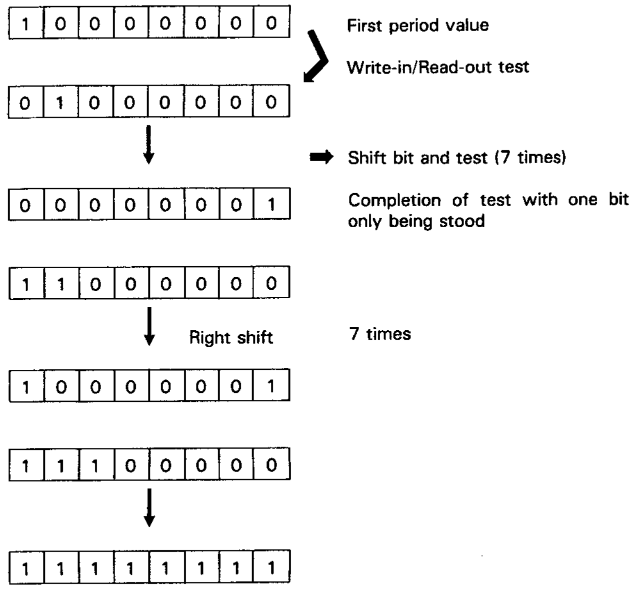


Table 9-7 Bit Shift Test (Right Shift)

| RAM address \ Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| 2 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 3 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| 4 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 5 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |

* Witness of neighbor influence by use of the fact that when a change to 0, 1, 0, 1 is made in the address column of the same bit, the neighboring addresses of the same address change to 0, 1, 0, 1.

Table 9-8 Checker Pattern

Cycle 1

| Address | Date |
|---|---|
| 0 | 0 0 |
| 1 | 0 1 |
| 2 | 0 2 |
| 3 | 0 3 |
| 4 | 0 4 |
| 5 | 0 5 |
| 6 | 0 6 |
| 7 | 0 7 |
| 8 | 0 8 |

Cycle 2

| Address | Date |
|---|---|
| 0 | 0 1 |
| 1 | 0 2 |
| 2 | 0 3 |
| 3 | 0 4 |
| 4 | 0 5 |
| 5 | 0 6 |
| 6 | 0 7 |
| 7 | 0 8 |
| 8 | 0 9 |

Cycle 256

| Address | Date |
|---|---|
| 0 | 0 2 |
| 1 | 0 3 |
| 2 | 0 4 |
| 3 | 0 5 |
| 4 | 0 6 |
| 5 | 0 7 |
| 6 | 0 8 |
| 7 | 0 9 |
| 8 | 0 A |

Table 9-9 Address Increment Pattern

## AFTER ALL TESTS HAVE BEEN COMPLETED, THE SAME TESTS ARE PERFORMED AGAIN FROM THE BEGINNING.

Test purposes

(1) 1. (all 0 test) and 2. (all 1 test) to determine if basic read/write is possible.

(2) 3. (Checker pattern test) and 4. (Reverse checker pattern test) to determine if there is influence from neighboring bits on the data line.

(3) 5. (Increment pattern test) examines if there is influence from the address line; for example, to discover a short in the address line.

(4) 6. (Bit shift pattern test) and 7. (Reverse bit shift pattern test) are performed to discover irregular line shorts and influence from surrounding addresses.

Table 9-10 RAM Test For CS-1720

```
                    EQU RAM=@1000    . START OF RAM AREA
                    EQU BYTE=@400    ; RAM AREA'S SIZE
                    ORG 00
             . ALL 0 TEST·
0000  210010        LXI HL RAM       ; SET RAM START
0003  010004        LXI BC BYTE      ; SET BYTE COUNTER
0006  1600          MVI D 0 ; SET DATA
0008  72     RT1    MOV M D
0009  23            INX HL
000A  0B            DCX BC
000B  79            MOV A C
000C  B0            ORA B
000D  C20800        JNZ RT1
             ; READ TEST
0010  210010        LXI HL RAM
0013  010004        LXI BC BYTE
0016  7E     RT3    MOV A M
0017  BA            CMP D
0019  CA1C00        JZ RT2
001B  76            HLT       ; ERROR
001C  23     RT2    INX HL
001D  0B            DCX BC
001E  79            MOV A C
001F  B0            ORA B    ; END ?
0020  C21600        JNZ RT3
             ;
             ; ALL 1 TEST
             ;
0023  210010        LXI HL RAM
0026  010004        LXI BC BYTE
0029  16FF          MVI D @0FF
002B  72     RT4    MOV M D
002C  23            INX HL
002D  0B            DCX BC
002E  79            MOV A C
002F  B0            ORA B
0030  C22B00        JNZ RT4
             ; READ TEST
0033  210010        LXI HL RAM
0036  010004        LXI BC BYTE
0039  7E     RT5    MOV A M ; GET DATA FROM RAM
003A  BA            CMP D   ; TEST MATCH
003B  CA3F00        JZ RT6  ; YES MUTCH
003E  76            HLT     ; ERROR
003F  23     RT6    INX HL
0040  0B            DCX BC
0041  79            MOV A C
0042  B0            ORA B
0043  C23900        JNZ RT5
             ;
             ; CHECKER PATTERN
             ;
0046  210010        LXI HL RAM
0049  010004        LXI BC BYTE
004C  1655          MVI D @55           PATTERN
004E  72     RT7    MOV M D
004F  7A            MOV A D
0050  2F            CMA
0051  57            MOV D A ; COMPLEMENT DATA SE
0052  23            INX HL
0053  0B            DCX BC
0054  79            MOV A C
0055  B0            ORA B
0056  C24E00        JNZ RT7
             ; READ TEST
0059  210010        LXI HL RAM
005C  010004        LXI BC BYTE
005F  1655          MVI D @55
0061  7E     RT8    MOV A M
0062  BA            CMP D    ; TEST MUTCH ?
0063  CA6700        JZ RT9   ; YES JMP
0066  76            HLT      ; ERROR
0067  23     RT9    INX HL
0068  7A            MOV A D
0069  2F            CMA
006A  57            MOV D A
006B  0B            DCX BC
006C  79            MOV A C
006D  B0            ORA B
006E  C26100        JNZ RT8
             ;
             ; INVERS CHECKER PATTERN
             ;
0071  210010        LXI HL RAM
0074  010004        LXI BC BYTE
0077  16AA          MVI D @0AA
0079  72     RT10   MOV M D
007A  7A            MOV A D
007B  2F            CMA
007C  57            MOV D A
007D  23            INX HL
007E  0B            DCX BC
007F  79            MOV A C
0080  B0            ORA B
0081  C27900        JNZ RT10
             ; READ TEST
0084  210010        LXI HL RAM
0087  010004        LXI BC BYTE
008A  16AA          MVI D @0AA
008C  7E     RT11   MOV A M
008D  BA            CMP D
008E  CA9200        JZ RT12
0091  76            HLT        ; NO MUTCH
0092  23     RT12   INX HL
0093  7A            MOV A D
0094  2F            CMA
0095  57            MOV D A
0096  0B            DCX BC
0097  79            MOV A C
0098  B0            ORA B
0099  C28C00        JNZ RT11
             ;
             ; INC PATTERN
             ;
009C  110000        LXI DE 00
009F  210010 RT14   LXI HL RAM
00A2  010004        LXI BC BYTE
```

# TROUBLESHOOTING

## TROUBLESHOOTING OF CPU UNIT (X81-1050-00)

### THE CPU BOARD DOES NOT RUN AT ALL

1. Check power supply voltage. Should be less than 5 V±5%.
2. Confirm the levels of the S 1 and S 0 terminals of μPD8085. Measure with the oscilloscope and check to see if both stop at zero level. If, when both are at zero level, the trap terminal is at high level, there may be trouble with the power supply detector circuit, or the detector level may not be set up properly.
3. Monitor the CLK terminal of μPD8085 with the oscilloscope. A 50% duty 1.79 MHz square wave should be obtained at this terminal. If it does not appear, monitor the x1 and x2 terminals with the oscilloscope to see if a sine wave signal of about 3.58 MHz is obtained. If it is not obtained, there may be malfunctioning of μPD8085 or ceramic resonator.
4. Confirm that the μPD8085 RESET OUT terminal is at low level. If it remains at high level and the above-mentioned clock operation is running normally, check if the $\overline{\text{RESET IN}}$ terminal of μPD8085 changes between low and high according to whether the power supply is on or off. If it does not change, there may be malfunctioning of C10, D7, and R21; if it changes, μPD8085 may be malfunctioning.
5. Confirm that the HLDA terminal of μPD8085 is at low level. If it is at high level, see if the HLD terminal is at high level. If the latter is at high level, there may be a problem with R20 or jumper resistor.
6. If none of the above mentioned problems apply, have the test programme chart (Table 9-7) run through the CPU board only. See the programme explanation for the method of analysis.

### DISPLAY FIGURES DO NOT MATCH INPUT FIGURES

1. Specified segment does not light up or stays lit.
   a) If, when changing the display number, the position of the segment which remains lit or unlit changes, the problem may be with the LED driver; if the position remains fixed, there may be a disconnection in the wiring or in the LED itself or there may be short.
   b) Make confirmation by test programming after repairs.
2. Numbers do not appear when number keys are pushed, or numbers appear when other than number keys are pushed.
   a) Have the test programme run. If numbers appear according to the prescribed pattern, the problem is in the keyboard.
   b) When numbers do not appear as prescribed in the test programme, there are two main sources of trouble.
      1) Trouble in the data bus.
      2) IC of the LED drive is malfunctioning.

   In the first case, there is faulty operation of some function when the keys are operated. For the second case, confirm with the oscilloscope that strobe signals are being received at IC1 and IC5 of the I/O board. If they are not being received, check the connection between the I/O board and the CPU board and check the operation of IC1 of the CPU board.
3. Switch condition as set at the CS-1720 panel cannot be realized. There are cases, in which several switches, not all switches, do not function as set.
   a) Check the connection of the flat cable above the CPU unit and the connection of the card edge connector.
   b) Remove the CPU unit and input a short card as a substitute; short the connector over the vertical switch panel with a flat cable and confirm that the switch set-up is normal. If there is an abnormality the trouble is with the switch unit.
   c) Set the test programme in the CPU unit and test the I/O board. If there are no abnormalities, examine the memory with the memory test programme.

### THE LEDS OF STEP SEQUENCE A, B, C, D DO NOT LIGHT UP

1. First push each key of A, B, C, D and check if the corresponding LED lights up.
2. When all the LEDs stay lit or unlit regardless of which any key is pushed and there are no abnormalities in the functioning of the other keys, confirm that the terminals corresponding to A, B, C, D LEDs of IC21 on the I/O board change in response to changes in pushing the A-D keys. If the LED remains unlit, the LED is malfunctioning, this means that the resistance to LED controlled current is disconnected or +5 V is not applied to the LED on the keyboard. If the voltage of IC21 output terminal does not change, check with the oscilloscope to see if strobe signal is being received at the 11 pin. When the LEDs remain the same in spite of being supplied, check to see if the 1 pin is at low level. If it is not low level, none of the LEDs will light up and the READ/WRITE LED will also not light up. If the 1 pin is at low level, test the memory with the memory test programme.

### THE BUZZER KEEPS SOUNDING

Confirm that the RT-1721 REMOTE BOX is connected adequately to the CS-1720. Next, push the keys of step sequence A, B, C, D. If the buzzer stops, the cause is too much noise from the RAM bit within the CS-1720. If it does not stop, check the Q1 operation of the horizontal mother board and the operation of the PHOTO-COUPLER TL521-1. If their operations are normal, the CPU board itself may be operating erratically. Examine the operation of the CPU board and the I/O board.

### LIGHTING OF THE READ/WRITE LED IS ABNORMAL

1. See if there is any change in the operation level of the

LED current restriction resistance (R19, R20), Q1, Q2 with alternately pushing the READ and ALL WRT keys. If conditions are normal, in like manner, while watching the 5 and 2 pins of IC21 on the I/O board, and observe if there is a change between high and low levels when alternately pushing the above-mentioned keys.

2. If there is no change in this latter case, check the strobe signal of the 11 pin of IC21. If there is no such signal, check the operation of the 3 pin of IC1 on the CPU board.
3. If conditions in the above cases are normal, there may be trouble with the data bus above the I/O board or malfunctioning of RAM and ROM. Therefore, test RAM and ROM. If these two checks are positive, execute the I/O board test programming.

### WARNING SIGNAL WHEN BATTERY IS 2.6 V OR MORE, OR 2.5 V OR LESS

1. Check the level of the RST5.5 terminal of μPD8085 on the CPU board. If normal, confirm that operation of the aforesaid corresponds to battery voltage.
2. The following may cause warning signals when the battery is 2.6 V or over.
   a) Incorrect operation of the IC4 comparator
   b) Malfunctioning of Q2
   c) Faulty VR1 adjustment
   d) Malfunctioning of D3
3. The following may cause warning signals when the battery is 2.5 V or below.
   a) Malfunctioning of IC4
   b) Q2 Base-Emitter short
   c) Short in ground somewhere between D5 and connector
   d) Opening of D3
   e) R5 disconnection

### PRINTER CANNOT BE DRIVEN

1. Check the printer unit and the cable.
2. Remove the cable, press the printer key and confirm that the buzzer sounds. If it does not, there may be a problem with R25 above the horizontal mother board, faulty connection between the CPU and I/O boards by the connector, or malfunctioning of Q4 above the CPU board.
3. If the buzzer sounds when the printer key is pressed even though the cable is attached, the problem may be a disconnection in the wiring to the DIN connector within the CS-1720 or a short in the D diode above the horizontal mother board.

### MEMORY PACK

1. When the finish buzzer does not sound even though the LOAD key is pressed from the memory pack, transmit dummy data one time via the save key and press the LOAD key once again. If the finish buzzer does not sound, there may be cable disconnection (including cable connector within CS-1720), faulty operation of IC1 or IC2 within the MEMORY PACK. For IC malfunctions, make confirmation with test programme.
2. The contents of the MEMORY PACK do not change after different contents are written in. Two distinct cases become apparent.
   a) When the contents of all the steps are loaded, they all become the same.
   b) The contents are not same but there is not change after writing in. In the case a), the problem may be that the IC3 counter does not operate or that the counter reset does not function. For the former, confirm that the count-up clock has been inputted into the 10 pin of IC3; For the later, examine the 11 pin of IC3. For the case b), it may be that the $\overline{WE}$ terminal is not receiving a signal from IC2.

### MEMORY TEST PROGRAMME

Perform tests by conducting write-in and read-out according to each pattern type throughout the entire memory area. If malfunctions occur, perform HLT. Since the HLT address varies according to each pattern, the pattern at stopping time can be judged by examining the stopped address.

1. All 0 test
   Perform test writing in all 0 throughout the memory area and seeing if all addresses become 0. If there is an error, perform HLT. The HLT address becomes 1 B.
2. All 1 test
   Write in 1 throughout the entire area and check if all addresses become 1. If there is an error, HLT is performed. The HLT address becomes 3 E.
3. Checker pattern test
   Write in 0 1 0 1 0 1 0 1 in the odd-number addresses and 1 0 1 0 1 0 1 0 in the even-number addresses.
   If there is an error, perform HLT at address 66.
4. Reverse checker pattern test
   In reverse of the above procedure, write in 1 0 1 0 1 0 1 0 in the odd-number addresses and 0 1 0 1 0 1 0 1 in the even-number addresses. If there is an error, perform HLT at address 91.
5. Increment pattern test
   Test all addresses by writing in +1 data to each address as it advances. +1 is added to the first period value of each test cycle for a total of 256 cycles. If errors occur, perform HLT at address BB.
6. Bit shift pattern test
   First stand one bit only to one address and perform write-in/read-out test. Next, after performing read/write test for each bit when all bit have been shifted to the right, stand two bits to perform the same procedure. The test continues until all bits are at 1. This procedure is conducted at all addresses. If errors occur, stop at address D9.

**Table 9-10 RAM Test For CS-1720**

```
                      EQU RAM=@1000    ; START OF RAM AREA
                      EQU BYTE=@400    ; RAM AREA'S SIZE
                      ORG 00
              ; ALL 0 TEST
0000  210010          LXI HL RAM       ; SET RAM START
0003  010004          LXI BC BYTE      ; SET BYTE COUNTER
0006  1600            MVI D 0 ; SET DATA
0008  72      RT1     MOV M D
0009  23              INX HL
000A  0B              DCX BC
000B  79              MOV A C
000C  B0              ORA B
000D  C20800          JNZ RT1
              ; READ TEST
0010  210010          LXI HL RAM
0013  010004          LXI BC BYTE
0016  7E      RT3     MOV A M
0017  BA              CMP D
0018  CA1C00          JZ RT2
001B  76              HLT       ; ERROR
001C  23      RT2     INX HL
001D  0B              DCX BC
001E  79              MOV A C
001F  B0              ORA B    ; END ?
0020  C21600          JNZ RT3
              ;
              ; ALL 1 TEST
              ;
0023  210010          LXI HL RAM
0026  010004          LXI BC BYTE
0029  16FF            MVI D @0FF
002B  72      RT4     MOV M D
002C  23              INX HL
002D  0B              DCX BC
002E  79              MOV A C
002F  B0              ORA B
0030  C22B00          JNZ RT4
              ; READ TEST
0033  210010          LXI HL RAM
0036  010004          LXI BC BYTE
0039  7E      RT5     MOV A M ; GET DATA FROM RAM
003A  BA              CMP D   ; TEST MATCH
003B  CA3F00          JZ RT6  ; YES MUTCH
003E  76              HLT     ; ERROR
003F  23      RT6     INX HL
0040  0B              DCX BC
0041  79              MOV A C
0042  B0              ORA B
0043  C23900          JNZ RT5
              ;
              ; CHECKER PATTERN
              ;
0046  210010          LXI HL RAM
0049  010004          LXI BC BYTE
004C  1655            MVI D @55          PATTERN
004E  72      RT7     MOV M D
004F  7A              MOV A D
0050  2F              CMA
0051  57              MOV D A ; COMPLEMENT DATA SET
0052  23              INX HL
0053  0B              DCX BC
0054  79              MOV A C
0055  B0              ORA B
0056  C24E00          JNZ RT7
              ; READ TEST
0059  210010          LXI HL RAM
005C  010004          LXI BC BYTE
005F  1655            MVI D @55
0061  7E      RT8     MOV A M
0062  BA              CMP D     ; TEST MUTCH ?
0063  CA6700          JZ RT9    ; YES JMP
0066  76              HLT       ; ERROR
0067  23      RT9     INX HL
0068  7A              MOV A D
0069  2F              CMA
006A  57              MOV D A
006B  0B              DCX BC
006C  79              MOV A C
006D  B0              ORA B
006E  C26100          JNZ RT8
              ;
              ; INVERS CHECKER PATTERN
              ;
0071  210010          LXI HL RAM
0074  010004          LXI BC BYTE
0077  16AA            MVI D @0AA
0079  72      RT10    MOV M D
007A  7A              MOV A D
007B  2F              CMA
007C  57              MOV D A
007D  23              INX HL
007E  0B              DCX BC
007F  79              MOV A C
0080  B0              ORA B
0081  C27900          JNZ RT10
              ; READ TEST
0084  210010          LXI HL RAM
0087  010004          LXI BC BYTE
008A  16AA            MVI D @0AA
008C  7E      RT11    MOV A M
008D  BA              CMP D
008E  CA9200          JZ RT12
0091  76              HLT       ; NO MUTCH
0092  23      RT12    INX HL
0093  7A              MOV A D
0094  2F              CMA
0095  57              MOV D A
0096  0B              DCX BC
0097  79              MOV A C
0098  B0              ORA B
0099  C28C00          JNZ RT11
              ;
              ; INC PATTERN
              ;
009C  110000          LXI DE 00
009F  210010  RT14    LXI HL RAM
00A2  010004          LXI BC BYTE
00A5  53              MOV D E
00A6  72      RT13    MOV M D
00A7  14              INR D
00A8  23              INX HL
00A9  0B              DCX BC
00AA  79              MOV A C
00AB  B0              ORA B
00AC  C2A600          JNZ RT13
              ; READ TEST
00AF  210010          LXI HL RAM
00B2  010004          LXI BC BYTE
00B5  53              MOV D E
00B6  7E      RT15    MOV A M
00B7  BA              CMP D
00B8  CABC00          JZ RT16
00BB  76              HLT       ; NO MUTCH
00BC  23      RT16    INX HL
00BD  14              INR D
00BE  0B              DCX BC
00BF  79              MOV A C
00C0  B0              ORA B
00C1  C2B600          JNZ RT15
              ; NEXT PATTERN
00C4  1D              DCR E
00C5  C29F00          JNZ RT14
              ;
              ; BIT SHIFT PATTERN
              ;
00C8  210010          LXI HL RAM
00CB  010004          LXI BC BYTE
00CE  AF      RT19    XRA A
00CF  110808          LXI DE @808
00D2  37      RT18    STC
00D3  1F              RAR
00D4  77      RT17    MOV M A
00D5  BE              CMP M
00D6  CADA00          JZ RT23
00D9  76              HLT       ; NOT MUTCH
00DA  0F      RT23    RRC
00DB  1D              DCR E
00DC  C2D400          JNZ RT17
00DF  0F              RRC
00E0  15              DCR D
00E1  C2D200          JNZ RT18
00E4  23              INX HL
00E5  0B              DCX BC
00E6  79              MOV A C
00E7  B0              ORA B
00E8  C2CE00          JNZ RT19
              ;
              ; REVERSE PATTERN TEST
              ; FOR EACH ADDRES
00EB  210010          LXI HL RAM
00EE  010004          LXI BC BYTE
00F1  AF      RT20    XRA A
00F2  110808          LXI DE @808
00F5  37      RT21    STC
00F6  17              RAL
00F7  77      RT22    MOV M A
00F8  BE              CMP M
00F9  CAFD00          JZ RT24
00FC  76              HLT       ; NOT MUTCH
00FD  07      RT24    RLC
00FE  1D              DCR E
00FF  C2F700          JNZ RT22
0102  07              RLC
0103  15              DCR D
0104  C2F500          JNZ RT21
0107  23              INX HL
0108  0B              DCX BC
0109  79              MOV A C
010A  B0              ORA B
010B  C2F100          JNZ RT20
010E  C30000          JMP 00
                      END
```

## I/O PORT TEST

Test Forms

0. All 0 test
1. All 1 test
2. Checker pattern test
3. Reverse checker pattern test
4. Increment pattern test

The contents are the same as that of the memory test. The I/O port test is performed by shorting the input/output port of each address and connecting the printer. If there is no abnormality, the buzzer sounds at the end, and the CPU performs HLT.

If errors occur, print the following in the printer for each error.

| | |
|---|---|
| Test pattern | displayed by 0 ~ 4 |
| Board | displayed by 0 ~ 7 |
| Data sent out | displayed by 00 ~ FF |
| Data received | displayed by 00 ~ FF (abnormal data) |

| Pin to be shorted | |
|---|---|
| 1 | 67 |
| 2 | 68 |
| 3 | 69 |
| 4 | 70 |
| 5 | 71 |
| 6 | 72 |
| 7 | 73 |
| 8 | 74 |
| 9 | 59 |
| 10 | 59 |
| 11 | 61 |
| 12 | 62 |
| 13 | 63 |
| 14 | 64 |
| 15 | 65 |
| 16 | 66 |

| Pin to be shorted | |
|---|---|
| 19 | 49 |
| 20 | 50 |
| 21 | 51 |
| 22 | 52 |
| 23 | 53 |
| 24 | 54 |
| 25 | 55 |
| 26 | 56 |
| 27 | 41 |
| 28 | 42 |
| 29 | 43 |
| 30 | 44 |
| 31 | 45 |
| 32 | 46 |
| 33 | 47 |
| 34 | 48 |

The P32 side should be treated as shown in the table above; for the P25 and P26 side, connection is made after reversing to right/left the flat cable with the connector attached.

**Table 9-11 I/O Port P32 Short Method**

**Table 9-12 I/O Port Test**

```
                          EQU     LEDS=@5000
                          EQU     RAM=@1000
                          EQU     STACK=@1400
                          EQU     BYTE=8
                          EQU     IOP=@9000
                          EQU     COUNT=@1000+9
                          ORG 00
                ;
0000  310014              LXI SP STACK
0003  AF                  XRA A
0004  320050              STA LEDS
0007  320910              STA COUNT
                ;
                ; ALL 0 TEST
                ;
000A  210010              LXI HL RAM
000D  010800              LXI BC BYTE
0010  1600                MVI D 0
0012  72        RT0       MOV M D
0013  23                  INX HL
0014  0D                  DCR C
0015  C21200              JNZ RT0
                ;
                ; END OFF WRITE
                ;
0018  CDA200              CALL TRANS
001B  CDBA00              CALL VER
001E  CD9A00              CALL UPC
                ;
                ; ALL 1 TEST
                ;
0021  210010              LXI HL RAM
0024  010800              LXI BC BYTE
0027  16FF                MVI D @FF
0029  72        RT2       MOV M D
002A  23                  INX HL
002B  0D                  DCR C
002C  C22900              JNZ RT2
                ;
002F  CDA200              CALL TRANS
0032  CDBA00              CALL VER
0035  CD9A00              CALL UPC
                ;
                ; TEST CHECKER
                ;
0038  210010              LXI HL RAM
003B  010800              LXI BC BYTE
003E  1655                MVI D @55
0040  72        RT3       MOV M D
0041  23                  INX HL
0042  7A                  MOV A D
0043  2F                  CMA
0044  57                  MOV D A
0045  0D                  DCR C
0046  C24000              JNZ RT3
                ;
```

```
0049  CDA200              CALL TRANS
004C  CDBA00              CALL VER
004F  CD9A00              CALL UPC
                ;
                ; INVERS PATTERN
                ;
0052  210010              LXI HL RAM
0055  010800              LXI BC BYTE
0058  16AA                MVI  D @AA
005A  72        RT4       MOV M D
005B  23                  INX HL
005C  7A                  MOV A D
005D  2F                  CMA
005E  57                  MOV D A
005F  0D                  DCR C
0060  C25A00              JNZ RT4
                ;
0063  CDA200              CALL TRANS
0066  CDBA00              CALL VER
0069  CD9A00              CALL UPC
                ;
                ; INC PATTERN
                ;
006C  110000              LXI DE 0
006F  210010    RT5       LXI HL RAM
0072  010800              LXI BC BYTE
0075  53                  MOV D E
0076  72        RT6       MOV M D
0077  23                  INX HL
0078  14                  INR D
0079  0D                  DCR C
007A  C27600              JNZ RT6
                ;
007D  CDA200              CALL TRANS
0080  CDBA00              CALL VER
0083  CD9A00              CALL UPC
                ;
0086  1D                  DCR E
0087  C26F00              JNZ RT5
008A  3EFF                MVI A @FF
008C  320050              STA LEDS
008F  110080              LXI DE @8000
0092  CD5101              CALL WA11M
0095  AF                  XRA A
0096  320050              STA LEDS
0099  76                  HLT
                ;
                ; MODE COUNTER UP
                ;
009A  3A0910    UPC       LDA COUNT
009D  3C                  INR A
009E  320910              STA COUNT
00A1  C9                  RET
                ;
                ; TRANS TO RAM TO IO PORT
                ;
00A2  D5        TRANS     PUSH DE
00A3  E5                  PUSH HL
00A4  C5                  PUSH BC
00A5  210010              LXI HL RAM
```

```
00A8
00AB
00AE
00AF
00B0
00B1
00B2
00B3
00B6
00B7
00B8
00B9


00BA
00BB
00BC
00BD
00C0
00C3
00C6
00C7
00C8

00CB
00CC
00CD
00CE
00D0
00D3
00D6
00D9
00DB
00DE
00DF
00E0
00E3
00E5
00E8
00E9
00EC
00EE
00F1
00F2
00F5
00F7
00FA
00FD
00FE
00FF
0100
0103
0104

0105
0106
0107
0108
010B
```

**Table 9-12  I/O Port Test**

```
                        EQU     LED8=@5000
                        EQU     RAM=@1000
                        EQU     STACK=@1400
                        EQU     BYTE=8
                        EQU     IOP=@8000
                        EQU     COUNT=@1000+9
                        ORG 00
                ;
0000  310014            LXI SP STACK
0003  AF                XRA A
0004  320050            STA LED8
0007  320910            STA COUNT
                ;
                ; ALL 0 TEST
                ;
000A  210010            LXI HL RAM
000D  010800            LXI BC BYTE
0010  1600              MVI D 0
0012  72        RT0     MOV M D
0013  23                INX HL
0014  0D                DCR C
0015  C21200            JNZ RT0
                ;
                ; END OFF WRITE
                ;
0018  CDA200            CALL TRANS
001B  CDBA00            CALL VER
001E  CD9A00            CALL UPC
                ;
                ; ALL 1 TEST
                ;
0021  210010            LXI HL RAM
0024  010800            LXI BC BYTE
0027  16FF              MVI D @FF
0029  72        RT2     MOV M D
002A  23                INX HL
002B  0D                DCR C
002C  C22900            JNZ RT2
                ;
002F  CDA200            CALL TRANS
0032  CDBA00            CALL VER
0035  CD9A00            CALL UPC
                ;
                ; TEST CHECKER
                ;
0038  210010            LXI HL RAM
003B  010800            LXI BC BYTE
003E  1655              MVI D @55
0040  72        RT3     MOV M D
0041  23                INX HL
0042  7A                MOV A D
0043  2F                CMA
0044  57                MOV D A
0045  0D                DCR C
0046  C24000            JNZ RT3
                ;

0049  CDA200            CALL TRANS
004C  CDBA00            CALL VER
004F  CD9A00            CALL UPC
                ;
                ; INVERS PATTERN
                ;
0052  210010            LXI HL RAM
0055  010800            LXI BC BYTE
0058  16AA              MVI  D @AA
005A  72        RT4     MOV M D
005B  23                INX HL
005C  7A                MOV A D
005D  2F                CMA
005E  57                MOV D A
005F  0D                DCR C
0060  C25A00            JNZ RT4
                ;
0063  CDA200            CALL TRANS
0066  CDBA00            CALL VER
0069  CD9A00            CALL UPC
                ;
                ; INC PATTERN
                ;
006C  110000            LXI DE 0
006F  210010    RT5     LXI HL RAM
0072  010800            LXI BC BYTE
0075  53                MOV D E
0076  72        RT6     MOV M D
0077  23                INX HL
0078  14                INR D
0079  0D                DCR C
007A  C27600            JNZ RT6
                ;
007D  CDA200            CALL TRANS
0080  CDBA00            CALL VER
0083  CD9A00            CALL UPC
                ;
0086  1D                DCR E
0087  C26F00            JNZ RT5
008A  3EFF              MVI A @FF
008C  320050            STA LED8
008F  110080            LXI DE @8000
0092  CD5101            CALL WA11M
0095  AF                XRA A
0096  320050            STA LED8
0099  76                HLT
                ;
                ; MODE COUNTER UP
                ;
009A  3A0910    UPC     LDA COUNT
009D  3C                INR A
009E  320910            STA COUNT
00A1  C9                RET
                ;
                ; TRANS TO RAM TO IO PORT
                ;
00A2  D5        TRANS   PUSH DE
00A3  E5                PUSH HL
00A4  C5                PUSH BC
00A5  210010            LXI HL RAM

00A8  110080            LXI DE IOP
00AB  010800            LXI BC BYTE
00AE  7E        TRANS1  MOV A M
00AF  12                STAX DE
00B0  23                INX HL
00B1  13                INX DE
00B2  0D                DCR C
00B3  C2AE00            JNZ TRANS1
00B6  C1                POP BC
00B7  E1                POP HL
00B8  D1                POP DE
00B9  C9                RET
                ;
                ; VERIFY TEST
                ;
00BA  E5        VER     PUSH HL
00BB  D5                PUSH DE
00BC  C5                PUSH BC
00BD  210010            LXI HL RAM
00C0  010800            LXI BC BYTE
00C3  110080            LXI DE IOP
00C6  1A        VER0    LDAX DE
00C7  BE                CMP M
00C8  CA0501            JZ VER1

00CB  E5                PUSH HL
00CC  C5                PUSH BC
00CD  C5                PUSH BC
00CE  0E00              MVI C 0
00D0  CD2E01            CALL COUT
00D3  3A0910            LDA COUNT
00D6  CD0F01            CALL AOUT
00D9  0E20              MVI C @20
00DB  CD2E01            CALL COUT
00DE  C1                POP BC
00DF  7D                MOV  A L
00E0  CD0F01            CALL AOUT
00E3  0E20              MVI C @20
00E5  CD2E01            CALL COUT
00E8  7E                MOV A M
00E9  CD0F01            CALL AOUT
00EC  0E20              MVI C @20
00EE  CD2E01            CALL COUT
00F1  1A                LDAX DE
00F2  CD0F01            CALL AOUT
00F5  0E0D              MVI C @0D
00F7  CD2E01            CALL COUT
00FA  01FFFF    WAIT    LXI BC @FFFF
00FD  0B        WAIT1   DCX BC
00FE  79                MOV A C
00FF  B0                ORA B
0100  C2FD00            JNZ WAIT1
0103  C1                POP BC
0104  E1                POP HL
                ;
0105  23        VER1    INX HL
0106  13                INX DE
0107  0D                DCR C
0108  C2C600            JNZ VER0
010B  C1                POP BC

010C  D1                POP DE
010D  E1                POP HL
010E  C9                RET
                ;
                ; ACC OUT
                ;
010F  F5        AOUT    PUSH PSW
0110  1F                RAR
0111  1F                RAR
0112  1F                RAR
0113  1F                RAR
0114  CD2401            CALL ASCII
0117  4F                MOV C A
0118  CD2E01            CALL COUT
011B  F1                POP PSW
011C  CD2401            CALL ASCII
011F  4F                MOV C A
0120  CD2E01            CALL COUT
0123  C9                RET
                ;
                ; CONVERT ASCII
                ;
0124  E60F      ASCII   ANI @0F
0126  C630              ADI @30
0128  FE3A              CPI @3A
012A  D8                RC
012B  C607              ADI 7
012D  C9                RET
                ;
                ; COUT
                ;
012E  F5        COUT    PUSH PSW
012F  3EC0              MVI A @C0
0131  0608              MVI B 8
0133  30        CO5     SIM
0134  111E00            LXI DE @1E
0137  CD5101            CALL WA11M
013A  79                MOV A C
013B  1F                RAR
013C  4F                MOV C A
013D  3E80              MVI A @80
013F  1F                RAR
0140  EE80              XRI @80
0142  05                DCR B
0143  F23301            JP CO5
0146  3E40              MVI A @40
0148  30                SIM
0149  113E00            LXI DE @3E
014C  CD5101            CALL WA11M
014F  D1                POP DE
0150  C9                RET
                ;
0151  1B        WA11M   DCX DE
0152  7B                MOV A  E
0153  B2                ORA D
0154  C25101            JNZ WA11M
0157  C9                RET
                        END
```

## KEY BOARD TEST

By pressing each key, the corresponding number is displayed on the 7 segment LED above the I/O board. The keys and displayed numbers are shown below.

| Key number | Value | Key number | Value |
|---|---|---|---|
| 0 | 22 | SCAN | 05 |
| 1 | 15 | D | 28 |
| 2 | 16 | DOWN | 30 |
| 3 | 17 | A | 07 |
| 4 | 08 | FREE | 06 |
| 5 | 09 | EXT | 13 |
| 6 | 10 | LOAD | 26 |
| 7 | 01 | SAVE | 19 |
| 8 | 02 | PRNT | 12 |
| 9 | 03 | Blank | 20 |
| START | 23 | Blank | 27 |
| END | 24 | | |
| PART WRT | 11 | | |
| ALL WRT | 18 | | |
| READ | 25 | | |
| STO | 04 | | |
| B | 14 | | |
| C | 21 | | |
| RST | 29 | | |
| UP | 31 | | |

Table 9-13

Table 9-14 Key Test For RT-1721

```
                     EQU     STACK=@1400
                     EQU     LED8=@5000
                     EQU     MASK6=@1D
                     EQU     EMPTY=@80
                     EQU     KERT=@6000
                     EQU     LED7=@4000
                     EQU     KROW=@3000
                ;
                     ORG 00
0000  3EF0           MVI A @F0
0002  320050         STA LED8
0005  AF             XRA A
0006  320040         STA LED7
0009  C35A00         JMP START
                ;
                     ORG @34
0034  F3      RSTK   DI
0035  F5             PUSH PSW
0036  C5             PUSH BC
0037  E5             PUSH HL
0038  D5             PUSH DE
0039  3E1F           MVI A @1F
003B  30             SIM
003C  3A0010         LDA KEYBF
003F  87             ADD A
0040  D25400         JNC RSTB
0043  CD9500  RSTA   CALL KDEC
0046  0600           MVI B 0
0048  4F             MOV C A
0049  21CF00         LXI HL TBL
004C  09             DAD BC
004D  7E             MOV A M
004E  320040         STA LED7
0051  CD8F00         CALL KCOA0
0054  D1      RSTB   POP DE
0055  E1             POP HL
0056  C1             POP BC
0057  F1             POP PSW
0058  FB             EI
0059  C9             RET
                ;
                ; MAIN PROGARM START
                ;
005A  310014  START  LXI SP STACK
005D  AF             XRA A
005E  2F             CMA
005F  320040         STA LED7
0062  3E1D           MVI A MASK6
0064  30             SIM
0065  CD8F00         CALL KCOA0
0068  FB      SCAN   EI
0069  CDC500         CALL WA10M
006C  F3             DI
006D  CD7300         CALL KSCAN
0070  C36800         JMP SCAN
                ;
```

```
0073  3A0060  KSCAN  LDA KERT
0076  E608           ANI 8
0078  C0             RNZ
0079  CD8C00  KSCA2  CALL KCOA4
007C  3A0110         LDA KDRIV
007F  07             RLC
0080  DA8500         JC KSCA1
0083  3EEF    KSCA0  MVI A @EF
0085  320030  KSCA1  STA KROW
0088  320110         STA KDRIV
008B  C9             RET
              ;
008C  3E1D    KCOA4  MVI A MASK6
008E  30             SIM
008F  3E80    KCOA0  MVI A EMPTY
0091  320010  KCOA2  STA KEYBF
0094  C9             RET
              ;
0095  CDC500  KDEC   CALL WA10M
0098  3A0060         LDA KERT
009B  E607           ANI 7
009D  47             MOV B A
009E  CDC500         CALL WA10M
00A1  3A0060         LDA KERT
00A4  E607           ANI 7
00A6  B8             CMP B
00A7  C28F00         JNZ KCOA0
00AA  320210         STA KRET
00AD  210000         LXI HL 0
00B0  3A0110         LDA KDRIV
00B3  87      DECA   ADD A
00B4  D2BB00         JNC ENDEC
00B7  2C             INR L
00B8  C3B300         JMP DECA
              ;
00BB  3A0210  ENDEC  LDA KRET
00BE  29             DAD HL
00BF  29             DAD HL
00C0  29             DAD HL
00C1  85             ADD L
00C2  C39100         JMP KCOA2
              ;
00C5  110002  WA10M  LXI DE @200
00C8  1B      WA11M  DCX DE
00C9  7B             MOV A E
00CA  B2             ORA D
00CB  C2C800         JNZ WA11M
00CE  C9             RET
              ;
00CF  22      TBL    @22
00D0  15             @15
00D1  16             @16
00D2  17             @17
00D3  08             @08
00D4  09             @09
00D5  10             @10
00D6  01             @01
00D7  02             @02
00D8  03             @03
00D9  23             @23
```

Table 9-14 Key Test For RT-1721

```
                  ;
                          EQU     STACK=@1400
                          EQU     LED8=@5000
                          EQU     MASK6=@1D
                          EQU     EMPTY=@80
                          EQU     KERT=@6000
                          EQU     LED7=@4000
                          EQU     KROW=@3000
                  ;
                          ORG 00
0000  3EF0                MVI A @F0
0002  320050              STA LED8
0005  AF                  XRA A
0006  320040              STA LED7
0009  C35A00              JMP START
                  ;
                          ORG @34
0034  F3          RSTK    DI
0035  F5                  PUSH PSW
0036  C5                  PUSH BC
0037  E5                  PUSH HL
0038  D5                  PUSH DE
0039  3E1F                MVI A @1F
003B  30                  SIM
003C  3A0010              LDA KEYBF
003F  87                  ADD A
0040  D25400              JNC RSTB
0043  CD9500      RSTA    CALL KDEC
0046  0600                MVI B 0
0048  4F                  MOV C A
0049  21CF00              LXI HL TBL
004C  09                  DAD BC
004D  7E                  MOV A M
004E  320040              STA LED7
0051  CD8F00              CALL KCOA0
0054  D1          RSTB    POP DE
0055  E1                  POP HL
0056  C1                  POP BC
0057  F1                  POP PSW
0058  FB                  EI
0059  C9                  RET
                  ;
                  ; MAIN PROGARM START
                  ;
005A  310014      START   LXI SP STACK
005D  AF                  XRA A
005E  2F                  CMA
005F  320040              STA LED7
0062  3E1D                MVI A MASK6
0064  30                  SIM
0065  CD8F00              CALL KCOA0
0068  FB          SCAN    EI
0069  CDC500              CALL WA10M
006C  F3                  DI
006D  CD7300              CALL KSCAN
0070  C36800              JMP SCAN
                  ;
0073  3A0060      KSCAN   LDA KERT
0076  E608                ANI 8
0078  C0                  RNZ
0079  CD8C00      KSCA2   CALL KCOA4
007C  3A0110              LDA KDRIV
007F  07                  RLC
0080  DA8500              JC KSCA1
0083  3EEF        KSCA0   MVI A @EF
0085  320030      KSCA1   STA KROW
0088  320110              STA KDRIV
008B  C9                  RET
                  ;
008C  3E1D        KCOA4   MVI A MASK6
008E  30                  SIM
008F  3E80        KCOA0   MVI A EMPTY
0091  320010      KCOA2   STA KEYBF
0094  C9                  RET
                  ;
0095  CDC500      KDEC    CALL WA10M
0098  3A0060              LDA KERT
009B  E607                ANI 7
009D  47                  MOV B A
009E  CDC500              CALL WA10M
00A1  3A0060              LDA KERT
00A4  E607                ANI 7
00A6  B8                  CMP B
00A7  C28F00              JNZ KCOA0
00AA  320210              STA KRET
00AD  210000              LXI HL 0
00B0  3A0110              LDA KDRIV
00B3  87          DECA    ADD A
00B4  D2BB00              JNC ENDEC
00B7  2C                  INR L
00B8  C3B300              JMP DECA
                  ;
00BB  3A0210      ENDEC   LDA KRET
00BE  29                  DAD HL
00BF  29                  DAD HL
00C0  29                  DAD HL
00C1  85                  ADD L
00C2  C39100              JMP KCOA2
                  ;
00C5  110002      WA10M   LXI DE @200
00C8  1B          WA11M   DCX DE
00C9  7B                  MOV A E
00CA  B2                  ORA D
00CB  C2C800              JNZ WA11M
00CE  C9                  RET
                  ;
00CF  22          TBL     @22
00D0  15                  @15
00D1  16                  @16
00D2  17                  @17
00D3  08                  @08
00D4  09                  @09
00D5  10                  @10
00D6  01                  @01
00D7  02                  @02
00D8  03                  @03
00D9  23                  @23
00DA  24                  @24
00DB  11                  @11
00DC  18                  @18
00DD  25                  @25
00DE  04                  @04
00DF  14                  @14
00E0  21                  @21
00E1  29                  @29
00E2  31                  @31
00E3  05                  @05
00E4  28                  @28
00E5  30                  @30
00E6  07                  @07
00E7  06                  @06
00E8  13                  @13
00E9  26                  @26
00EA  19                  @19
00EB  12                  @12
00EC  20                  @20
00ED  27                  @27
                  ;
                          ORG @1000
1000              KEYBF   BLK 1
1001              KDRIV   BLK 1
1002              KRET    BLK 1
                          END
```

## LED TEST

After displaying figures 00 ~ 99 on the 7 segment LED, light the WRITE LED and the READ LED in sequence, sound the buzzer, and light the A, B, C, D step sequence LED.

Repeat the same process.

### LED And A, B, C, D, LED And 7 Seg LED Disp

```
                               EQU      LED7-@4000
                               EQU      LED8-@5000
                               ORG 00
0000  310014                   LXI SP @1400

0003  0E64    LEDT0    MVI C @64
0005  AF               XRA A
0006  320040  LEDT     STA LED7
0009  CD2500           CALL WA100M
000C  CE01             ADI 1
000E  27               DAA
000F  0D               DCR C
0010  C20600           JNZ LEDT
0013  0E09             MVI C 9
0015  3E01             MVI A 1
0017  320050  LEDT1    STA LED8
001A  CD2500           CALL WA100M
001D  87               ADD A
001E  0D               DCR C
001F  C21700           JNZ LEDT1
0022  C30300           JMP LEDT0

0025  110009  WA100M   LXI DE @900
0028  1B      WA101M   DCX DE
0029  7B               MOV A E
002A  B2               ORA D
002B  C22800           JNZ WA101M
002E  C9               RET
                       END
```

## MEMORY PACK TEST

The test process is the same as that of the memory test within the CS-1720. Results are displayed above printer as follows:

- The error-producing address which corresponds to the CS-1720 memory.
- Data at normal times
- Incorrect data

The procedure is first to write in on the memory the same pattern as that of the memory test, transmit it to the memory pack, and compare this pattern with the memory within the CS-1720.

The address when errors are generated must be converted from the memory address within CS-1720 to the real address above the memory pack.

## SWITCH PROCEDURE

Real address = (address − 8000 + 1) × 2

(Note: numbers are expressed in hexadecimal digits)

Example: When an error occurs at address 8010,

8010-8000 + 1 = 11

11 × 2 = 22

As this shows, the error was generated at memory pack address 22.

### Ram Pack Test All Pattern

```
                 ;
                         EQU RAM=@1000
                         EQU STACK=@1400
                         EQU BYTE=@200
                         EQU RESET=@6000
                         EQU PACK=@7000
                 ;
                         ORG 00
0000  310014             LXI SP STACK      ; SET STACK POINTER
                 ;
                 ; ALL 0 READ WRITE TEST
                 ;
0003  210010             LXI HL RAM
0006  010002             LXI BC BYTE
0009  1600               MVI D 00
000B  72         RT1     MOV M D
000C  23                 INX HL
000D  0B                 DCX BC
000E  79                 MOV A C
000F  B0                 ORA B
0010  C20B00             JNZ RT1
                 ; END OF INTERNAL RAM WRITE
0013  CD8100             CALL TRANS        ; TRANS TO RAM PACK
0016  CDA400             CALL VER          ; VERIFY TEST
                 ;
                 ; ALL 1 TEST
                 ;
0019  210010             LXI HL RAM
001C  010002             LXI BC BYTE
001F  16FF               MVI D @0FF
0021  72         RT2     MOV M D
0022  23                 INX HL
0023  0B                 DCX BC
0024  79                 MOV A C
0025  B0                 ORA B
0026  C22100             JNZ RT2
                 ;
0029  CD8100             CALL TRANS
002C  CDA400             CALL VER          ; VERIFY TEST
                 ;
                 ; TEST CHECKER PATTERN
                 ;
002F  210010             LXI HL RAM
0032  010002             LXI BC BYTE
0035  1655               MVI D @55
0037  72         RT3     MOV M D
0038  23                 INX HL
0039  7A                 MOV A D
003A  2F                 CMA
003B  57                 MOV D A
003C  0B                 DCX BC
003D  79                 MOV A C
003E  B0                 ORA B
003F  C23700             JNZ RT3
                 ;
0042  CD8100             CALL TRANS
0045  CDA400             CALL VER
```

```
                 ;
                 ;INVERS CHECKER
                 ;
0048  210010             LXI HL RAM
004B  010002             LXI BC BYTE
004E  16AA               MVI D @0AA
0050  72         RT4     MOV M D
0051  23                 INX HL
0052  7A                 MOV A D
0053  2F                 CMA
0054  57                 MOV D A
0055  0B                 DCX BC
0056  79                 MOV A C
0057  B0                 ORA B
0058  C25000             JNZ RT4
                 ;
005B  CD8100             CALL TRANS
005E  CDA400             CALL VER
                 ;
                 ; INC PATTERN
                 ;
0061  110000             LXI DE 0
0064  210010     RT5     LXI HL RAM
0067  010002             LXI BC BYTE
006A  53                 MOV D E
006B  72         RT6     MOV M D
006C  14                 INR D
006D  23                 INX HL
006E  0B                 DCX BC
006F  79                 MOV A C
0070  B0                 ORA B
0071  C26B00             JNZ RT6
                 ;
0074  CD8100             CALL TRANS
0077  CDA400             CALL VER
                 ;
007A  1D                 DCR E
007B  C26400             JNZ RT5 ; TEST AGAIN
                 ;
007E  C30000             JMP 00
                 ;
                 ; TRANS TO RAM PACK
                 ;
0081  D5         TRANS   PUSH DE
0082  E5                 PUSH HL
0083  C5                 PUSH BC
0084  320060             STA RESET
0087  210010             LXI HL RAM
008A  010002             LXI BC BYTE       ; SET BYTE COUNT
008D  7E         TRANS1  MOV A M
008E  1F                 RAR
008F  1F                 RAR
0090  1F                 RAR
0091  1F                 RAR
0092  320070             STA PACK
0095  7E                 MOV A M
0096  320070             STA PACK
0099  23                 INX HL
009A  0B                 DCX BC
009B  79                 MOV A C
```

## Ram Pack Test All Pattern

```
                ;
                        EQU RAM=@1000
                        EQU STACK=@1400
                        EQU BYTE=@200
                        EQU RESET=@6000
                        EQU PACK=@7000
                ;
                        ORG 00
0000  310014            LXI SP STACK      ; SET STACK POINTER
                ;
                ; ALL 0 READ WRITE TEST
                ;
0003  210010            LXI HL RAM
0006  010002            LXI BC BYTE
0009  1600              MVI D 00
000B  72        RT1     MOV M D
000C  23                INX HL
000D  0B                DCX BC
000E  79                MOV A C
000F  B0                ORA B
0010  C20B00            JNZ RT1
                ; END OF INTERNAL RAM WRITE
0013  CD8100            CALL TRANS        ; TRANS TO RAM PACK
0016  CDA400            CALL VER          ; VERIFY TEST
                ;
                ; ALL 1 TEST
                ;
0019  210010            LXI HL RAM
001C  010002            LXI BC BYTE
001F  16FF              MVI D @0FF
0021  72        RT2     MOV M D
0022  23                INX HL
0023  0B                DCX BC
0024  79                MOV A C
0025  B0                ORA B
0026  C22100            JNZ RT2
                ;
0029  CD8100            CALL TRANS
002C  CDA400            CALL VER          ; VERIFY TEST
                ;
                ; TEST CHECKER PATTERN
                ;
002F  210010            LXI HL RAM
0032  010002            LXI BC BYTE
0035  1655              MVI D @55
0037  72        RT3     MOV M D
0038  23                INX HL
0039  7A                MOV A D
003A  2F                CMA
003B  57                MOV D A
003C  0B                DCX BC
003D  79                MOV A C
003E  B0                ORA B
003F  C23700            JNZ RT3
                ;
0042  CD8100            CALL TRANS
0045  CDA400            CALL VER
```

```
                ;
                ;INVERS CHECKER
                ;
0048  210010            LXI HL RAM
004B  010002            LXI BC BYTE
004E  16AA              MVI D @0AA
0050  72        RT4     MOV M D
0051  23                INX HL
0052  7A                MOV A D
0053  2F                CMA
0054  57                MOV D A
0055  0B                DCX BC
0056  79                MOV A C
0057  B0                ORA B
0058  C25000            JNZ RT4
                ;
005B  CD8100            CALL TRANS
005E  CDA400            CALL VER
                ;
                ; INC PATTERN
                ;
0061  110000            LXI DE 0
0064  210010    RT5     LXI HL RAM
0067  010002            LXI BC BYTE
006A  53                MOV D E
006B  72        RT6     MOV M D
006C  14                INR D
006D  23                INX HL
006E  0B                DCX BC
006F  79                MOV A C
0070  B0                ORA B
0071  C26B00            JNZ RT6
                ;
0074  CD8100            CALL TRANS
0077  CDA400            CALL VER
                ;
007A  1D                DCR E
007B  C26400            JNZ RT5 ; TEST AGAIN
                ;
007E  C30000            JMP 00
                ;
                ; TRANS TO RAM PACK
                ;
0081  D5        TRANS   PUSH DE
0082  E5                PUSH HL
0083  C5                PUSH BC
0084  320060            STA RESET
0087  210010            LXI HL RAM
008A  010002            LXI BC BYTE       ; SET BYTE COUNTER
008D  7E        TRANS1  MOV A M
008E  1F                RAR
008F  1F                RAR
0090  1F                RAR
0091  1F                RAR
0092  320070            STA PACK
0095  7E                MOV A M
0096  320070            STA PACK
0099  23                INX HL
009A  0B                DCX BC
009B  79                MOV A C
```

```
009C  B0                ORA B
009D  C28D00            JNZ TRANS1
00A0  C1                POP BC
00A1  E1                POP HL
00A2  D1                POP DE
00A3  C9                RET
                ;
                ; VERIFY CHECK
                ;
00A4  E5        VER     PUSH HL
00A5  D5                PUSH DE
00A6  C5                PUSH BC
00A7  210010            LXI HL RAM
00AA  010002            LXI BC BYTE
00AD  320060            STA RESET
00B0  3A0070    VER0    LDA PACK          ; GET DATA FROM RAM PACK
00B3  87                ADD A
00B4  87                ADD A
00B5  87                ADD A
00B6  87                ADD A
00B7  57                MOV D A ; SAVE DATA HIGH 4 BIT
00B8  3A0070            LDA PACK
00BB  E60F              ANI @0F
00BD  B2                ORA D   ; GET DATA 8 BIT
00BE  BE                CMP M   ; TEST COMPARE
00BF  CAFA00            JZ VER1
                ;
00C2  C5                PUSH BC
00C3  F5                PUSH PSW
00C4  C5                PUSH BC
00C5  0E00              MVI C 00
00C7  CD0501            CALL COUT
00CA  0E20              MVI C @20
00CC  CD0501            CALL COUT
00CF  C1                POP BC
00D0  7C                MOV A H
00D1  CD2F01            CALL AOUT
00D4  7D                MOV A L
00D5  CD2F01            CALL AOUT
00D8  0E20              MVI C @20
00DA  CD0501            CALL COUT
00DD  7E                MOV A M
00DE  CD2F01            CALL AOUT
00E1  0E20              MVI C @20
00E3  CD0501            CALL COUT
00E6  F1                POP PSW
00E7  CD2F01            CALL AOUT
00EA  0E0D              MVI C @0D
00EC  CD0501            CALL COUT
00EF  01FFFF    WAIT    LXI BC @FFFF
00F2  0B        WAIT1   DCX BC
00F3  79                MOV A C
00F4  B0                ORA B
00F5  C2F200            JNZ WAIT1
00F8  C1                POP BC
00F9  E1                POP HL
00FA  23        VER1    INX HL
00FB  0B                DCX BC
00FC  79                MOV A C
00FD  B0                ORA B
```

```
00FE  C2B000            JNZ VER0
0101  C1                POP BC
0102  D1                POP DE
0103  E1                POP HL
0104  C9                RET
                ;
                ; C OUT
                ;
0105  D5        COUT    PUSH DE
0106  0EC0              MVI C @C0
0108  0608              MVI B 8
010A  30        C05     SIM
010B  111E00            LXI DE @1E
010E  CD2801            CALL WA11M
0111  79                MOV A C
0112  1F                RAR
0113  4F                MOV C A
0114  3E80              MVI A @80
0116  1F                RAR
0117  EE80              XRI @80
0119  05                DCR B
011A  F20A01            JP C05
011D  3E40              MVI A @40
011F  30                SIM
0120  113E00            LXI DE @3E
0123  CD2801            CALL WA11M
0126  D1                POP DE
0127  C9                RET
                ;
0128  1B        WA11M   DCX DE
0129  7B                MOV A E
012A  B2                ORA D
012B  C22801            JNZ WA11M
012E  C9                RET
                ;
                ; ACC OUT
                ;
012F  F5        AOUT    PUSH PSW
0130  1F                RAR
0131  1F                RAR
0132  1F                RAR
0133  1F                RAR
0134  CD4401            CALL ASCII
0137  4F                MOV C A
0138  CD0501            CALL COUT
013B  F1                POP PSW
013C  CD4401            CALL ASCII
013F  4F                MOV C A
0140  CD0501            CALL COUT
0143  C9                RET
                ;
                ; CONVERT ASCII
                ;
0144  E60F      ASCII   ANI @0F
0146  C630              ADI @30
0148  FE3A              CPI @3A
014A  D8                RC
014B  C607              ADI 7
014D  C9                RET
                        END
```

# PARTS LIST

Unless otherwise specified, all resistors are ±5%, 1/6W and all capacitor's voltage ratings are 50WV.

**The specifications and parts list and schematic diagram may be changed without notice owing to a technical innovation.**

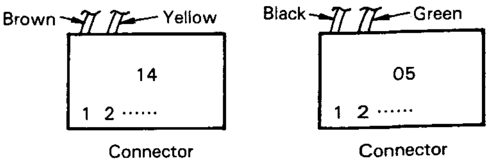
## ABBREVIATIONS

| **Resistor** | |
|---|---|
| RD<br>RN<br>RC<br>VR | Carbon<br>Metal film<br>Solid<br>Variable or Semi-fixed |
| **Capacitor** | |
| CC<br>CK<br>CE<br>CM<br>CQ<br>TC | Ceramic<br>Ceramic<br>Electrolytic<br>Mica<br>Mylar (Polypropylen)<br>Ceramic trimmer |
| **Semiconductor** | |
| TR<br>FET | Transistor<br>Field effect transistor |

The part No. of each connector is stamped or color-coded. The color-coding is as follows.

| Black | Brown | Red | Orange | Yellow | Green | Blue | Purple | Grey | White |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

## Example



Each connector can be classified by the color of pin 1 and pin 2.

# PARTS LIST

**ATTENUATOR UNIT (X75-1130-00)**

| Fig. & Index No. | Ref. No. | Parts No. | Description | | | |
|---|---|---|---|---|---|---|
| B-2 | R1 | RD14BB2E105J | RD | 1MΩ | ±5% | 1/4W |
| B-2 | R2 | RN14BK2H9903F | RN | 990kΩ | ±1% | 1/2W |
| | R3 | No use | | | | |
| C-2 | R4 | RN14BK2E1012F | RN | 10.1kΩ | ±1% | 1/4W |
| C-2 | R5 | RD14BB2C180J | RD | 18Ω | | |
| | R6 | No use | | | | |
| C-2 | R7 | RN14BK2H9003F | RN | 900kΩ | ±1% | 1/2W |
| C-2 | R8 | RN14BK2E1113F | RN | 111kΩ | ±1% | 1/4W |
| C-2 | R9 | RD14BB2C560J | RD | 56Ω | | |
| C-2 | R10 | RD14BB2C330J | RD | 33Ω | | |
| C-2 | R11 | RN14BK2E1004F | RN | 1MΩ | ±1% | 1/4W |
| C-2 | R12 | RD14BB2E104J | RD | 100kΩ | ±5% | 1/4W |
| C-2 | R13 | RD14BB2C101J | RD | 100Ω | | |
| D-1 | R14 | RN14BK2B1202F | RN | 12kΩ | ±1% | 1/8W |
| D-2 | R15 | RN14BK2B1202F | RN | 12kΩ | ±1% | 1/8W |
| D-2 | R16 | RD14BB2C470J | RD | 47Ω | | |
| D-2 | R17 | RD14BB2C470J | RD | 47Ω | | |
| D-2 | R18 | RD14BB2C332J | RD | 3.3kΩ | | |
| D-2 | R19 | RD14BB2C332J | RD | 3.3kΩ | | |
| | R20 | No use | | | | |
| B-3 | R21 | RD14BB2E105J | RD | 1MΩ | ±5% | 1/4W |
| B-3 | R22 | RN14BK2H9903F | RN | 990kΩ | ±1% | 1/2W |
| | R23 | No use | | | | |
| C-3 | R24 | RN14BK2E1012F | RN | 10.1kΩ | ±1% | 1/4W |
| C-3 | R25 | RD14BB2C180J | RD | 18Ω | | |
| | R26 | No use | | | | |
| C-3 | R27 | RN14BK2H9003F | RN | 900kΩ | ±1% | 1/2W |
| C-3 | R28 | RN14BK2E1113F | RN | 111kΩ | ±1% | 1/4W |
| C-3 | R29 | RD14BB2C560J | RD | 56Ω | | |
| C-3 | R30 | RD14BB2C330J | RD | 33Ω | | |
| C-3 | R31 | RN14BK2E1004F | RN | 1MΩ | ±1% | 1/4W |
| C-3 | R32 | RD14BB2E104J | RD | 100kΩ | ±5% | 1/4W |
| C-3 | R33 | RD14BB2C101J | RD | 100Ω | | |
| D-3 | R34 | RN14BK2B1202F | RN | 12kΩ | ±1% | 1/8W |
| D-3 | R35 | RN14BK2B1202F | RN | 12kΩ | ±1% | 1/8W |
| D-3 | R36 | RD14BB2C470J | RD | 47Ω | | |
| D-3 | R37 | RD14BB2C470J | RD | 47Ω | | |
| D-3 | R38 | RD14BB2C332J | RD | 3.3kΩ | | |
| D-3 | R39 | RD14BB2C332J | RD | 3.3KΩ | | |
| | R40 | No use | | | | |
| B-1 | R41 | RD14BB2C222J | RD | 2.2kΩ | | |
| B-1 | R42 | RD14BB2C222J | RD | 2.2kΩ | | |
| C-1 | R43 | RD14BB2C222J | RD | 2.2kΩ | | |
| C-1 | R44 | RD14BB2C222J | RD | 2.2kΩ | | |
| B-1 | R45 | RD14BB2C622J | RD | 6.2kΩ | | |
| D-1 | R46 | RD14BB2C102J | RD | 1KΩ | | |
| D-1 | R47 | RD14BB2C103J | RD | 10kΩ | | |
| B-4 | R48 | RD14BB2C222J | RD | 2.2kΩ | | |
| B-4 | R49 | RD14BB2C222J | RD | 2.2kΩ | | |
| C-4 | R50 | RD14BB2C222J | RD | 2.2kΩ | | |
| C-4 | R51 | RD14BB2C222J | RD | 2.2kΩ | | |
| B-4 | R52 | RD14BB2C622J | RD | 6.2kΩ | | |
| B-1 | VR1 | R12-2405-05 | VR | 5kΩB | | |
| B-1 | VR2 | R12-2405-05 | VR | 5kΩB | | |
| C-1 | VR3 | R12-2405-05 | VR | 5kΩB | | |
| C-1 | VR4 | R12-2405-05 | VR | 5kΩB | | |
| B-1 | VR5 | R12-0531-05 | VR | 500ΩB | | |
| B-4 | VR6 | R12-2405-05 | VR | 5kΩB | | |
| B-4 | VR7 | R12-2405-05 | VR | 5kΩB | | |
| C-4 | VR8 | R12-2405-05 | VR | 5kΩB | | |
| C-4 | VR9 | R12-2405-05 | VR | 5kΩB | | |
| B-4 | VR10 | R12-0531-05 | VR | 500ΩB | | |
| D-2 | VR11 | R12-1510-05 | VR | 1kΩB | | |
| D-3 | VR12 | R12-1510-05 | VR | 1kΩB | | |
| D-1 | VR13 | R12-2405-05 | VR | 5kΩB | | |
| B-2 | C1 | C91-0501-05 | Metal film | 0.047μF | ±10% | 630V |
| B-2 | C2 | CC45CH1H020C | CC | 2pF | ±0.25pF | |
| | C3 | No use | | | | |
| C-2 | C4 | CM93BD2A151J | CM | 150pF | ±5% | 100V |
| C-2 | C5 | CM93BD2A330J | CM | 33pF | ±5% | 100V |
| C-2 | C6 | C91-0502-05 | Metal film | 0.01μF | ±10% | 630V |
| | C7 | No use | | | | |
| D-2 | C8 | CE04W1A470M | CE | 47μF | | 10V |
| D-2 | C9 | CE04W1C220M | CE | 22μF | | 16V |
| A-1 | C10 | CE04W1C470M | CE | 47μF | | 16V |
| B-3 | C11 | C91-0501-05 | Metal film | 0.047μF | ±10% | 630V |
| B-3 | C12 | CC45CH1H020C | CC | 2pF | ±0.25pF | |
| | C13 | No use | | | | |

| Fig. & Index No. | Ref. No. | Parts No. | Description | | | |
|---|---|---|---|---|---|---|
| C-3 | C14 | CM93BD2A151J | CM | 150pF | ±5% | 100V |
| C-3 | C15 | CM93BD2A330J | CM | 33pF | ±5% | 100V |
| C-3 | C16 | C91-0502-05 | Metal film | 0.01μF | ±10% | 630V |
| | C17 | No use | | | | |
| D-3 | C18 | CE04W1A470M | CE | 47μF | | 10V |
| D-3 | C19 | CE04W1C220M | CE | 22μF | | 16V |
| A-3 | C20 | CE04W1C470M | CE | 47μF | | 16V |
| D-1 | C21 | CE041C470M | CE | 47μF | | 16V |
| C-1 | C22 | CE04W1C220M | CE | 22μF | | 16V |
| D-1 | C23 | CE04W1C220M | CE | 22μF | | 16V |
| D-1 | C24 | CK45B1H472K | CK | 4700pF | ±10% | |
| C-1 | C25 | CK45B1H472K | CK | 4700pF | ±10% | |
| B-1 | C26 | CK45B1H472K | CK | 4700pF | ±10% | |
| B-1 | C27 | CK45B1H472K | CK | 4700pF | ±10% | |
| C-1 | C28 | CK45B1H472K | CK | 4700pF | ±10% | |
| C-1 | C29 | CK45B1H472K | CK | 4700pF | ±10% | |
| B-1 | C30 | CK45B1H472K | CK | 4700pF | ±10% | |
| C-1 | C31 | CK45B1H472K | CK | 4700pF | ±10% | |
| D-4 | C32 | CE04W1C470M | CE | 47μF | | 16V |
| C-4 | C33 | CE04W1C220M | CE | 22μF | | 16V |
| D-4 | C34 | CK45B1H472K | CK | 4700pF | ±10% | |
| D-4 | C35 | CK45B1H472K | CK | 4700pF | ±10% | |
| C-4 | C36 | CK45B1H472K | CK | 4700pF | ±10% | |
| B-3 | C37 | CK45B1H472K | CK | 4700pF | ±10% | |
| B-3 | C38 | CK45B1H472K | CK | 4700pF | ±10% | |
| C-3 | C39 | CK45B1H472K | CK | 4700pF | ±10% | |
| C-3 | C40 | CK45B1H472K | CK | 4700pF | ±10% | |
| B-3 | C41 | CK45B1H472K | CK | 4700pF | ±10% | |
| C-3 | C42 | CK45B1H472K | CK | 4700pF | ±10% | |
| B-2 | TC1 | C05-0405-05 | TC | 20pF | | |
| B-2 | TC2 | C05-0403-05 | TC | 6pF | | |
| C-2 | TC3 | C05-0405-05 | TC | 20pF | | |
| C-2 | TC4 | C05-0403-05 | TC | 6pF | | |
| B-3 | TC5 | C05-0405-05 | TC | 20pF | | |
| B-3 | TC6 | C05-0403-05 | TC | 6pF | | |
| C-3 | TC7 | C05-0405-05 | TC | 20pF | | |
| C-3 | TC8 | C05-0403-05 | TC | 6pF | | |
| C-1 | L1 | L40-4701-03 | Ferri inductor | 47μH | | |
| D-1 | L2 | L40-4701-03 | Ferri inductor | 47μH | | |
| C-4 | L3 | L40-4701-03 | Ferri inductor | 47μH | | |
| D-4 | L4 | L40-4701-03 | Ferri inductor | 47μH | | |
| B-2 | RL1 | S51-1510-05 | Relay | | | |
| B-2 | RL2 | S51-1510-05 | Relay | | | |
| B-2 | RL3 | S51-2504-05 | Relay | | | |
| C-2 | RL4 | S51-2504-05 | Relay | | | |
| B-3 | RL5 | S51-1510-05 | Relay | | | |
| B-3 | RL6 | S51-1510-05 | Relay | | | |
| B-3 | RL7 | S51-2504-05 | Relay | | | |
| C-3 | RL8 | S51-2504-05 | Relay | | | |
| D-1 | RL9 | S51-1509-05 | Relay | | | |
| D-3 | RL10 | S51-1509-05 | Relay | | | |
| D-2 | Q1 | | TR | μPA70A (L) | | |
| D-2 | Q2 | | TR | 2SC1963 | | |
| D-3 | Q3 | | TR | μPA70A (L) | | |
| D-3 | Q4 | | TR | 2SC1963 | | |
| C-1 | D1 | | Diode | 1S1544A | | |
| C-1 | D2 | | Diode | 1S1544A | | |
| C-3 | D3 | | Diode | 1S1544A | | |
| C-3 | D4 | | Diode | 1S1544A | | |
| B-1 | D5 | | Diode | DS442X | | |
| B-1 | D6 | | Diode | DS442X | | |
| B-1 | D7 | | Diode | DS442X | | |
| C-1 | D8 | | Diode | DS442X | | |
| B-3 | D9 | | Diode | DS442X | | |
| B-3 | D10 | | Diode | DS442X | | |
| B-3 | D11 | | Diode | DS442X | | |
| C-3 | D12 | | Diode | DS442X | | |
| D-1 | D13 | | Diode | WZ-075 | | |
| B-1 | P1 | E40-0576-05 | Pin connector 5P | | | |
| B-4 | P2 | E40-0576-05 | Pin connector 5P | | | |
| C-1 | P3 | E40-0876-05 | Pin connector 8P | | | |
| C-4 | P4 | E40-0776-05 | Pin connector 7P | | | |
| D-2 | P5 | E40-0576-05 | Pin connector 5P | | | |

# PARTS LIST

## VERTICAL AMPLIFIER UNIT (X73-1420-00)

| Fig. & Index No. | Ref. No. | Parts No. | Description |
|---|---|---|---|
| D-3 | P6 | E40-0576-05 | Pin connector 5P |
| | | F11-0974-14 | Shield case |
| | | J32-0826-04 | Hex post |
| | | J25-2939-12 | Printed circuit board |

| Fig. & Index No. | Ref. No. | Parts No. | Description | | | |
|---|---|---|---|---|---|---|
| E-2 | R1 | RD14BB2C470J | RD | 47Ω | | |
| E-2 | R2 | RD14BB2C470J | RD | 47Ω | | |
| E-2 | R3 | RN14BK2B75ROF | RN | 75Ω | ±1% | 1/8W |
| E-2 | R4 | RN14BK2B75ROF | RN | 75Ω | ±1% | 1/8W |
| E-3 | R5 | RD14BB2C101J | RD | 100Ω | | |
| E-3 | R6 | RD14BB2C101J | RD | 100Ω | | |
| E-3 | R7 | RD14BB2C392J | RD | 3.9kΩ | | |
| E-3 | R8 | RD14BB2C472J | RD | 4.7kΩ | | |
| E-3 | R9 | RD14BB2C102J | RD | 1kΩ | | |
| E-3 | R10 | RD14BB2C391J | RD | 390Ω | | |
| E-2 | R11 | RN14BK2B4300F | RN | 430Ω | ±1% | 1/8W |
| E-2 | R12 | RN14BK2B4300F | RN | 430Ω | ±1% | 1/8W |
| E-3 | R13 | RN14BK2B2400F | RN | 240Ω | ±1% | 1/8W |
| E-3 | R14 | RN14BK2B68ROF | RN | 68Ω | ±1% | 1/8W |
| D-3 | R15 | RD14BB2C332J | RD | 3.3kΩ | | |
| D-3 | R16 | RN14BK2B1200F | RN | 120Ω | ±1% | 1/8W |
| D-3 | R17 | RD14BB2C470J | RD | 47Ω | | |
| D-3 | R18 | RD14BB2C470J | RD | 47Ω | | |
| E-2 | R19 | RD14BB2C472J | RD | 4.7kΩ | | |
| E-2 | R20 | RD14BB2C472J | RD | 4.7kΩ | | |
| E-2 | R21 | RD14BB2C472J | RD | 4.7kΩ | | |
| D-2 | R22 | RD14BB2C472J | RD | 4.7kΩ | | |
| E-2 | R23 | RD14BB2C472J | RD | 4.7kΩ | | |
| E-2 | R24 | RD14BB2C512J | RD | 5.1kΩ | | |
| E-2 | R25 | RD14BB2C361J | RD | 360Ω | | |
| D-2 | R26 | RD14BB2C332J | RD | 3.3kΩ | | |
| D-2 | R27 | RD14BB2C113J | RD | 11kΩ | | |
| D-2 | R28 | RD14BB2C471J | RD | 470Ω | | |
| D-3 | R29 | RD14BB2C472J | RD | 4.7kΩ | | |
| D-3 | R30 | RD14BB2C472J | RD | 4.7kΩ | | |
| D-3 | R31 | RD14BB2C470J | RD | 47Ω | | |
| D-3 | R32 | RD14BB2C470J | RD | 47Ω | | |
| D-2 | R33 | RD14BB2C272J | RD | 2.7kΩ | | |
| D-2 | R34 | RD14BB2C681J | RD | 680Ω | | |
| D-2 | R35 | RD14BB2C681J | RD | 680Ω | | |
| D-2 | R36 | RD14BB2C681J | RD | 680Ω | | |
| D-3 | R37 | RD14BB2C820J | RD | 82Ω | | |
| D-2 | R38 | RD14BB2C103J | RD | 10kΩ | | |
| D-3 | R39 | RN14BK2B1800F | RN | 180Ω | ±1% | 1/8W |
| D-2 | R40 | RN14BK2B1800F | RN | 180Ω | ±1% | 1/8W |
| D-2 | R41 | RD14BB2C101J | RD | 100Ω | | |
| D-3 | R42 | RD14BB2C101J | RD | 100Ω | | |
| D-2 | R43 | RD14BB2C272J | RD | 2.7kΩ | | |
| D-3 | R44 | RD14BB2C222J | RD | 2.2kΩ | | |
| D-3 | R45 | RN14BK2B1801F | RN | 1.8kΩ | ±1% | 1/8W |
| D-2 | R46 | RN14BK2B1801F | RN | 1.8kΩ | ±1% | 1/8W |
| D-3 | R47 | RD14BB2C362J | RD | 3.6kΩ | | |
| D-3 | R48 | RD14BB2C470J | RD | 47Ω | | |
| D-3 | R49 | RD14BB2C470J | RD | 47Ω | | |
| D-3 | R50 | RD14BB2C222J | RD | 2.2kΩ | | |
| D-3 | R51 | RD14BB2C222J | RD | 2.2kΩ | | |
| D-3 | R52 | RD14BB2C470J | RD | 47Ω | | |
| D-3 | R53 | RD14BB2C470J | RD | 47Ω | | |
| D-2 | R54 | RN14BK2B1001F | RN | 1kΩ | ±1% | 1/8W |
| D-2 | R55 | RN14BK2B1001F | RN | 1kΩ | ±1% | 1/8W |
| D-2 | R56 | RD14BB2C301J | RD | 300Ω | | |
| C-2 | R57 | RD14BB2C123J | RD | 12kΩ | | |
| C-3 | R58 | RD14BB2C123J | RD | 12kΩ | | |
| D-3 | R59 | RD14BB2C222J | RD | 2.2kΩ | | |
| D-3 | R60 | RD14BB2C222J | RD | 2.2kΩ | | |
| D-2 | R61 | RD14BB2C222J | RD | 2.2kΩ | | |
| C-3 | R62 | RD14BB2C101J | RD | 100Ω | | |
| C-2 | R63 | RD14BB2C101J | RD | 100Ω | | |
| C-2 | R64 | RD14BB2C222J | RD | 2.2kΩ | | |
| C-3 | R65 | RN14BK2B4700F | RN | 470Ω | ±1% | 1/8W |
| C-2 | R66 | RN14BK2B4700F | RN | 470Ω | ±1% | 1/8W |
| C-3 | R67 | RD14BB2C470J | RD | 47Ω | | |
| C-2 | R68 | RD14BB2C470J | RD | 47Ω | | |
| C-3 | R69 | RD14BB2C392J | RD | 3.9kΩ | | |
| C-2 | R70 | RD14BB2C392J | RD | 3.9kΩ | | |
| C-3 | R71 | RD14BB2C470J | RD | 47Ω | | |
| C-2 | R72 | RD14BB2C470J | RD | 47Ω | | |
| C-3 | R73 | RD14BB2C271J | RD | 270Ω | | |
| C-2 | R74 | RD14BB2C331J | RD | 330Ω | | |
| C-2 | R75 | RD14BB2C182J | RD | 1.8kΩ | | |
| C-3 | R76 | RD14BB2C182J | RD | 1.8kΩ | | |
| C-3 | R77 | RD14BB2C470J | RD | 47Ω | | |
| C-2 | R78 | RD14BB2C470J | RD | 47Ω | | |
| C-3 | R79 | RD14BB2C151J | RD | 150Ω | | |
| C-3 | R80 | RD14BB2C182J | RD | 1.8kΩ | | |

# PARTS LIST

| Fig. & Index No. | Ref. No. | Parts No. | Description | | | |
|---|---|---|---|---|---|---|
| C-3 | R81 | RD14BB2C182J | RD | 1.8kΩ | | |
| C-3 | R82 | RD14BB2C470J | RD | 47Ω | | |
| C-2 | R83 | RD14BB2C470J | RD | 47Ω | | |
| C-2 | R84 | RD14BB2C151J | RD | 150Ω | | |
| C-2 | R85 | RN14BK2B6800F | RN | 680Ω | ±1% | 1/8W |
| C-2 | R86 | RN14BK2B6800F | RN | 680Ω | ±1% | 1/8W |
| C-3 | R87 | RD14BB2C101J | RD | 100Ω | | |
| C-3 | R88 | RD14BB2C101J | RD | 100Ω | | |
| C-3 | R89 | RD14BB2C472J | RD | 4.7kΩ | | |
| C-3 | R90 | RD14BB2C101J | RD | 100Ω | | |
| C-2 | R91 | RD14BB2C101J | RD | 100Ω | | |
| C-3 | R92 | RD14BB2C472J | RD | 4.7kΩ | | |
| C-3 | R93 | RD14BB2C472J | RD | 4.7kΩ | | |
| B-3 | R94 | RD14BB2C102J | RD | 1kΩ | | |
| B-3 | R95 | RD14BB2C562J | RD | 5.6kΩ | | |
| B-3 | R96 | RD14BB2C562J | RD | 5.6kΩ | | |
| B-3 | R97 | RD14BB2C101J | RD | 100Ω | | |
| B-3 | R98 | RD14BB2C101J | RD | 100Ω | | |
| B-2 | R99 | RD14BB2C472J | RD | 4.7kΩ | | |
| C-2 | R100 | RD14BB2C222J | RD | 2.2kΩ | | |
| E-1 | R101 | RD14BB2C470J | RD | 47Ω | | |
| E-1 | R102 | RD14BB2C470J | RD | 47Ω | | |
| E-1 | R103 | RN14BK2B75R0F | RN | 75Ω | ±1% | 1/8W |
| E-1 | R104 | RN14BK2B75R0F | RN | 75Ω | ±1% | 1/8W |
| E-2 | R105 | RD14BB2C101J | RD | 100Ω | | |
| E-2 | R106 | RD14BB2C101J | RD | 100Ω | | |
| E-2 | R107 | RD14BB2C392J | RD | 3.9kΩ | | |
| E-2 | R108 | RD14BB2C472J | RD | 4.7kΩ | | |
| E-2 | R109 | RD14BB2C102J | RD | 1kΩ | | |
| E-1 | R110 | RD14BB2C391J | RD | 390Ω | | |
| E-1 | R111 | RN14BK2B4300F | RN | 430Ω | ±1% | 1/8W |
| E-1 | R112 | RN14BK2B4300F | RN | 430Ω | ±1% | 1/8W |
| E-2 | R113 | RN14BK2B2400F | RN | 240Ω | ±1% | 1/8W |
| E-2 | R114 | RN14BK2B68R0F | RN | 68Ω | ±1% | 1/8W |
| D-1 | R115 | RD14BB2C332J | RD | 3.3kΩ | | |
| D-1 | R116 | RN14BK2B1200F | RN | 120Ω | ±1% | 1/8W |
| D-1 | R117 | RD14BB2C470J | RD | 47Ω | | |
| D-1 | R118 | RD14BB2C470J | RD | 47Ω | | |
| E-1 | R119 | RD14BB2C472J | RD | 4.7kΩ | | |
| E-1 | R120 | RD14BB2C472J | RD | 4.7kΩ | | |
| E-1 | R121 | RD14BB2C472J | RD | 4.7kΩ | | |
| D-1 | R122 | RD14BB2C472J | RD | 4.7kΩ | | |
| E-1 | R123 | RD14BB2C472J | RD | 4.7kΩ | | |
| E-1 | R124 | RD14BB2C512J | RD | 5.1kΩ | | |
| E-1 | R125 | RD14BB2C361J | RD | 360Ω | | |
| D-1 | R126 | RD14BB2C332J | RD | 3.3kΩ | | |
| D-1 | R127 | RD14BB2C113J | RD | 11kΩ | | |
| D-1 | R128 | RD14BB2C471J | RD | 470Ω | | |
| D-2 | R129 | RD14BB2C472J | RD | 4.7kΩ | | |
| D-2 | R130 | RD14BB2C472J | RD | 4.7kΩ | | |
| D-2 | R131 | RD14BB2C470J | RD | 47Ω | | |
| D-2 | R132 | RD14BB2C470J | RD | 47Ω | | |
| D-1 | R133 | RD14BB2C222J | RD | 2.2kΩ | | |
| D-1 | R134 | RD14BB2C681J | RD | 680Ω | | |
| D-1 | R135 | RD14BB2C681J | RD | 680Ω | | |
| D-1 | R136 | RD14BB2C681J | RD | 680Ω | | |
| D-2 | R137 | RD14BB2C820J | RD | 82Ω | | |
| D-1 | R138 | RD14BB2C103J | RD | 10kΩ | | |
| D-2 | R139 | RN14BK2B1800F | RN | 180Ω | ±1% | 1/8W |
| D-1 | R140 | RN14BK2B1800F | RN | 180Ω | ±1% | 1/8W |
| D-1 | R141 | RD14BB2C101J | RD | 100Ω | | |
| D-2 | R142 | RD14BB2C101J | RD | 100Ω | | |
| D-1 | R143 | RD14BB2C272J | RD | 2.7kΩ | | |
| D-2 | R144 | RD14BB2C222J | RD | 2.2kΩ | | |
| D-2 | R145 | RN14BK2B1801F | RN | 1.8kΩ | ±1% | 1/8W |
| D-1 | R146 | RN14BK2B1801F | RN | 1.8kΩ | ±1% | 1/8W |
| D-2 | R147 | RD14BB2C362J | RD | 3.6kΩ | | |
| D-2 | R148 | RD14BB2C470J | RD | 47Ω | | |
| D-2 | R149 | RD14BB2C470J | RD | 47Ω | | |
| D-2 | R150 | RD14BB2C222J | RD | 2.2kΩ | | |
| D-2 | R151 | RD14BB2C222J | RD | 2.2kΩ | | |
| D-2 | R152 | RD14BB2C470J | RD | 47Ω | | |
| D-2 | R153 | RD14BB2C470J | RD | 47Ω | | |
| D-2 | R154 | RD14BB2C470J | RD | 47Ω | | |
| D-2 | R155 | RD14BB2C470J | RD | 47Ω | | |
| D-1 | R156 | RN14BK2B1001F | RN | 1kΩ | ±1% | 1/8W |
| D-1 | R157 | RN14BK2B1001F | RN | 1kΩ | ±1% | 1/8W |
| D-1 | R158 | RN14BK2B3000F | RN | 300Ω | ±1% | 1/8W |
| D-1 | R159 | RN14BK2B1001F | RN | 1kΩ | ±1% | 1/8W |
| D-1 | R160 | RN14BK2B1001F | RN | 1kΩ | ±1% | 1/8W |

| Fig. & Index No. | Ref. No. | Parts No. | Description | | | |
|---|---|---|---|---|---|---|
| C-1 | R161 | RN14BK2B3000F | RN | 300Ω | ±1% | 1/8W |
| D-1 | R162 | RD14BB2C472J | RD | 4.7kΩ | | |
| D-1 | R163 | RD14BB2C472J | RD | 4.7kΩ | | |
| D-1 | R164 | RD14BB2C103J | RD | 10kΩ | | |
| D-1 | R165 | RD14BB2C103J | RD | 10kΩ | | |
| C-1 | R166 | RD14BB2C472J | RD | 4.7kΩ | | |
| C-1 | R167 | RD14BB2C472J | RD | 4.7kΩ | | |
| C-1 | R168 | RD14BB2C103J | RD | 10kΩ | | |
| C-1 | R169 | RD14BB2C103J | RD | 10kΩ | | |
| C-2 | R170 | RD14BB2C123J | RD | 12kΩ | | |
| C-1 | R171 | RD14BB2C123J | RD | 12kΩ | | |
| C-2 | R172 | RD14BB2C222J | RD | 2.2kΩ | | |
| C-2 | R173 | RD14BB2C222J | RD | 2.2kΩ | | |
| C-1 | R174 | RD14BB2C222J | RD | 2.2kΩ | | |
| C-2 | R175 | RD14BB2C101J | RD | 100Ω | | |
| C-1 | R176 | RD14BB2C101J | RD | 100Ω | | |
| C-1 | R177 | RD14BB2C222J | RD | 2.2kΩ | | |
| C-2 | R178 | RN14BK2B4700F | RN | 470Ω | ±1% | 1/8W |
| C-1 | R179 | RN14BK2B4700F | RN | 470Ω | ±1% | 1/8W |
| C-2 | R180 | RD14BB2C470J | RD | 47Ω | | |
| C-1 | R181 | RD14BB2C470J | RD | 47Ω | | |
| C-2 | R182 | RD14BB2C392J | RD | 3.9kΩ | | |
| C-1 | R183 | RD14BB2C392J | RD | 3.9kΩ | | |
| C-2 | R184 | RD14BB2C151J | RD | 150Ω | | |
| C-2 | R185 | RD14BB2C470J | RD | 47Ω | | |
| C-1 | R186 | RD14BB2C470J | RD | 47Ω | | |
| C-2 | R187 | RD14BB2C182J | RD | 1.8kΩ | | |
| C-1 | R188 | RD14BB2C182J | RD | 1.8kΩ | | |
| C-2 | R189 | RD14BB2C471J | RD | 470Ω | | |
| C-1 | R190 | RD14BB2C471J | RD | 470Ω | | |
| C-1 | R191 | RD14BB2C221J | RD | 220Ω | | |
| C-1 | R192 | RD14BB2C102J | RD | 1kΩ | | |
| C-1 | R193 | RD14BB2C102J | RD | 1kΩ | | |
| C-1 | R194 | RD14BB2C151J | RD | 150Ω | | |
| C-2 | R195 | RD14BB2C470J | RD | 47Ω | | |
| C-1 | R196 | RD14BB2C470J | RD | 47Ω | | |
| C-1 | R197 | RN14BK2B6800F | RN | 680Ω | ±1% | 1/8W |
| C-1 | R198 | RN14BK2B6800F | RN | 680Ω | ±1% | 1/8W |
| C-2 | R199 | RD14BB2C101J | RD | 100Ω | | |
| B-1 | R200 | RD14BB2C101J | RD | 100Ω | | |
| B-2 | R201 | RD14BB2C472J | RD | 4.7kΩ | | |
| B-1 | R202 | RD14BB2C101J | RD | 100Ω | | |
| B-2 | R203 | RD14BB2C101J | RD | 100Ω | | |
| B-2 | R204 | RD14BB2C472J | RD | 4.7kΩ | | |
| B-1 | R205 | RD14BB2C472J | RD | 4.7kΩ | | |
| C-2 | R206 | RD14BB2C222J | RD | 2.2kΩ | | |
| B-3 | R207 | RN14BK2B1001F | RN | 1kΩ | ±1% | 1/8W |
| B-2 | R208 | RN14BK2B1001F | RN | 1kΩ | ±1% | 1/8W |
| B-3 | R209 | RN14BK2B1001F | RN | 1kΩ | ±1% | 1/8W |
| B-2 | R210 | RN14BK2B1001F | RN | 1kΩ | ±1% | 1/8W |
| B-3 | R211 | RD14BB2C223J | RD | 22kΩ | | |
| B-2 | R212 | RD14BB2C472J | RD | 4.7kΩ | | |
| B-2 | R213 | RD14BB2C472J | RD | 4.7kΩ | | |
| B-2 | R214 | RD14BB2C472J | RD | 4.7kΩ | | |
| B-3 | R215 | RD14BB2C470J | RD | 47Ω | | |
| B-2 | R216 | RD14BB2C470J | RD | 47Ω | | |
| B-3 | R217 | RD14BB2C102J | RD | 1kΩ | | |
| B-2 | R218 | RD14BB2C102J | RD | 1kΩ | | |
| B-2 | R219 | RD14BB2C102J | RD | 1kΩ | | |
| B-3 | R220 | RD14BB2C470J | RD | 47Ω | | |
| B-2 | R221 | RD14BB2C470J | RD | 47Ω | | |
| B-3 | R222 | RD14BB2C221J | RD | 220Ω | | |
| B-2 | R223 | RD14BB2C221J | RD | 220Ω | | |
| B-3 | R224 | RD14BB2C910J | RD | 91Ω | | |
| B-2 | R225 | RD14BB2C910J | RD | 91Ω | | |
| B-1 | R226 | RD14BB2C181J | RD | 180Ω | | |
| B-2 | R227 | RD14BB2C470J | RD | 47Ω | | |
| B-1 | R228 | RD14BB2C470J | RD | 47Ω | | |
| B-1 | R229 | RD14BB2C272J | RD | 2.7kΩ | | |
| B-1 | R230 | RD14BB2C333J | RD | 33kΩ | | |
| B-1 | R231 | RD14BB2C301J | RD | 300Ω | | |
| B-1 | R232 | RD14BB2C301J | RD | 300Ω | | |
| B-1 | R233 | RD14BB2C271J | RD | 270Ω | | |
| B-2 | R234 | RD14BB2C202J | RD | 2kΩ | | |
| B-1 | R235 | RD14BB2C234J | RD | 2kΩ | | |
| B-2 | R236 | RN14BK2B4700F | RN | 470Ω | ±1% | 1/8W |
| B-1 | R237 | RN14BK2B4700F | RN | 470Ω | ±1% | 1/8W |
| B-2 | R238 | RD14BB2C102J | RD | 1kΩ | | |
| B-2 | R239 | RD14BB2C100J | RD | 10Ω | | |
| B-1 | R240 | RD14BB2C121J | RD | 120Ω | | |

# PARTS LIST

| Fig. & Index No. | Ref. No. | Parts No. | Description | | | |
|---|---|---|---|---|---|---|
| B-1 | R241 | RD14BB2C101J | RD | 100Ω | | |
| B-2 | R242 | RD14BB2C361J | RD | 360Ω | | |
| B-1 | R243 | RD14BB2C103J | RD | 10kΩ | | |
| B-1 | R244 | RD14BB2C222J | RD | 2.2kΩ | | |
| B-1 | R245 | RD14BB2C152J | RD | 1.5kΩ | | |
| B-2 | R246 | RD14BB2C392J | RD | 3.9kΩ | | |
| A-1 | R247 | RD14BB2C222J | RD | 2.2kΩ | | |
| A-2 | R248 | RD14BB2C182J | RD | 1.8kΩ | | |
| A-2 | R249 | RD14BB2C470J | RD | 47Ω | | |
| B-2 | R250 | RD14BB2C470J | RD | 47Ω | | |
| B-1 | R251 | RD14BB2C470J | RD | 47Ω | | |
| A-1 | R252 | RD14BB2C470J | RD | 47Ω | | |
| B-2 | R253 | RD14BB2C472J | RD | 4.7kΩ | | |
| B-2 | R254 | RD14BB2C472J | RD | 4.7kΩ | | |
| B-2 | R255 | RD14BB2C472J | RD | 4.7kΩ | | |
| B-2 | R256 | RD14BB2C472J | RD | 4.7kΩ | | |
| B-2 | R257 | RD14BB2C472J | RD | 4.7kΩ | | |
| B-2 | R258 | RD14BB2C472J | RD | 4.7kΩ | | |
| C-2 | R259 | RD14BB2C472J | RD | 4.7kΩ | | |
| C-2 | R260 | RD14BB2C101J | RD | 100Ω | | |
| C-2 | R261 | RD14BB2C472J | RD | 4.7kΩ | | |
| C-2 | R262 | RD14BB2C472J | RD | 4.7kΩ | | |
| D-2 | R263 | RD14BB2C101J | RD | 100Ω | | |
| D-2 | R264 | RD14BB2C472J | RD | 4.7kΩ | | |
| B-2 | R265 | RD14BB2C472J | RD | 4.7kΩ | | |
| B-2 | R266 | RD14BB2C472J | RD | 4.7kΩ | | |
| B-2 | R267 | RD14BB2C101J | RD | 100Ω | | |
| B-2 | R268 | RD14BB2C472J | RD | 4.7kΩ | | |
| B-2 | R269 | RD14BB2C331J | RD | 330Ω | | |
| C-2 | R270 | RD14BB2C222J | RD | 2.2kΩ | | |
| C-2 | R271 | RD14BB2C222J | RD | 2.2kΩ | | |
| C-2 | R272 | RD14BB2C183J | RD | 18kΩ | | |
| B-1 | R273 | RD14BB2C183J | RD | 18kΩ | | |
| B-2 | R274 | RD14BB2C332J | RD | 3.3kΩ | | |
| B-3 | R275 | RD14BB2C104J | RD | 100kΩ | | |
| C-3 | R276 | RD14BB2C104J | RD | 100kΩ | | |
| D-2 | VR1 | R12-0502-05 | VR | 100ΩB | | |
| D-2 | VR2 | R12-0511-05 | VR | 220ΩB | | |
| C-3 | VR3 | R12-0511-05 | VR | 220ΩB | | |
| D-1 | VR4 | R12-0502-05 | VR | 100ΩB | | |
| D-1 | VR5 | R12-0511-05 | VR | 220ΩB | | |
| D-1 | VR6 | R12-0511-05 | VR | 220ΩB | | |
| C-1 | VR7 | R12-0511-05 | VR | 220ΩB | | |
| C-1 | VR8 | R12-1037-05 | VR | 3.3kΩB | | |
| C-2 | VR9 | R12-0511-05 | VR | 220ΩB | | |
| B-3 | VR10 | R12-1037-05 | VR | 3.3kΩB | | |
| B-2 | VR11 | R12-1033-05 | VR | 2.2kΩB | | |
| C-2 | VR12 | R12-1033-05 | VR | 2.2kΩB | | |
| C-2 | VR13 | R12-1033-05 | VR | 2.2kΩB | | |
| | C1 | No use | | | | |
| E-2 | C2 | CE04W1C470M | CE | 47μF | | 16V |
| E-2 | C3 | CK45B1H103K | CK | 0.01μF | ±10% | |
| E-2 | C4 | CE04W1C470M | CE | 47μF | | 16V |
| D-2 | C5 | CC45CH1H180J | CC | 18pF | ±5% | |
| D-3 | C6 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-2 | C7 | CE04BW1H010M | CE | 1μF | | 50V |
| D-2 | C8 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-2 | C9 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-2 | C10 | CC45CH1H150J | CC | 15pF | ±5% | |
| D-3 | C11 | CE04BW1H010M | CE | 1μF | | 50V |
| C-3 | C12 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-2 | C13 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-2 | C14 | CE04BW1H010M | CE | 1μF | | 50V |
| C-3 | C15 | CC45CH1H150J | CC | 15pF | ±5% | |
| C-2 | C16 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-3 | C17 | CC45CH1H120J | CC | 12pF | ±5% | |
| B-2 | C18 | CK45B1H103K | CK | 0.01μF | ±10% | |
| A-2 | C19 | CE04W1C470M | CE | 47μF | | 16V |
| B-2 | C20 | CK45B1H103K | CK | 0.01μF | ±10% | |
| A-2 | C21 | CE04W1C470M | CE | 47μF | | 16V |
| A-3 | C22 | CE04W1A102M | CE | 1000μF | | 10V |
| B-3 | C23 | CK45B1H103K | CK | 0.01μF | ±10% | |
| E-1 | C24 | CC45CH1H070D | CC | 7pF | ±0.5pF | |
| E-1 | C25 | CE04W1C470M | CE | 47μF | | 16V |
| E-1 | C26 | CK45B1H103K | CK | 0.01μF | ±10% | |
| E-1 | C27 | CE04W1C470M | CE | 47μF | | 16V |
| D-2 | C28 | CE04BW1H010M | CE | 1μF | | 50V |
| D-1 | C29 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-1 | C30 | CC45CH1H220J | CC | 22pF | ±5% | |
| C-1 | C31 | CC45CH1H220J | CC | 22pF | ±5% | |
| C-2 | C32 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-2 | C33 | CE04BW1H010M | CE | 1μF | | 50V |
| C-1 | C34 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-2 | C35 | CE04BW1H010M | CE | 1μF | | 50V |
| C-2 | C36 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-2 | C37 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-1 | C38 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-1 | C39 | CC45SL1H101J | CC | 100pF | ±5% | |
| C-2 | C40 | CC45SL1H101J | CC | 100pF | ±5% | |
| C-1 | C41 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-1 | C42 | CC45CH1H120J | CC | 12pF | ±5% | |
| B-3 | C43 | CK45B1H103K | CK | 0.01μF | ±10% | |
| B-1 | C44 | CC45CH1H470J | CC | 47pF | ±5% | |
| B-1 | C45 | CC45CH1H560J | CC | 56pF | ±5% | |
| B-1 | C46 | CC45CH1H100D | CC | 10pF | ±0.5pF | |
| B-1 | C47 | CC45SL1H331J | CC | 330pF | ±5% | |
| B-1 | C48 | CK45B1H103K | CK | 0.01μF | ±10% | |
| B-2 | C49 | CK45B1H102K | CK | 1000pF | ±10% | |
| B-1 | C50 | CK45B1H103K | CK | 0.01μF | ±10% | |
| B-2 | C51 | CC45SL1H220J | CC | 22pF | ±5% | |
| B-2 | C52 | CC45SL1H220J | CC | 22pF | ±5% | |
| B-2 | C53 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-2 | C54 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-2 | C55 | CK45B1H103K | CK | 0.01μF | ±10% | |
| B-2 | C56 | CK45B1H103K | CK | 0.01μF | ±10% | |
| B-2 | C57 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-1 | C58 | CE04W1C470M | CE | 47μF | | 16V |
| B-1 | C59 | CK45B1H103K | CK | 0.01μF | ±10% | |
| B-1 | C60 | CE04W1C470M | CE | 47μF | | 16V |
| B-1 | C61 | CK45B1H103K | CK | 0.01μF | ±10% | |
| B-1 | C62 | CE04W1C470M | CE | 47μF | | 16V |
| B-1 | C63 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-3 | C64 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-2 | C65 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-2 | C66 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-3 | C67 | CC45SL1H221J | CC | 220pF | ±5% | |
| C-2 | C68 | CC45SL1H221J | CC | 220pF | ±5% | |
| B-3 | C69 | CC45CH1H150J | CC | 15pF | ±5% | |
| B-2 | C70 | CC45CH1H150J | CC | 15pF | ±5% | |
| | C71 | No use | | | | |
| | C72 | No use | | | | |
| B-2 | C73 | CC45CH1H100D | CC | 10pF | ±0.5pF | |
| D-2 | C74 | CK45B1H103K | CK | 0.01μF | ±10% | |
| E-3 | C75 | CC45CH1H100D | CC | 10pF | ±0.5pF | |
| E-3 | C76 | CC45CH1H180J | CC | 18pF | ±5% | |
| E-2 | C77 | CC45CH1H100D | CC | 10pF | ±0.5pF | |
| E-2 | C78 | CC45CH1H180J | CC | 18pF | ±5% | |
| B-1 | C79 | CK45B1H103K | CK | 0.01μF | ±10% | |
| B-3 | C80 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-2 | C81 | CK45B1H103K | CK | 0.01μF | ±10% | |
| A-2 | C82 | CC45CH1H220J | CC | 22pF | ±5% | |
| B-2 | C83 | CK45B1H102K | CK | 1000pF | ±10% | |
| D-2 | TC1 | C05-0505-05 | TC | 20pF | | |
| D-1 | TC2 | C05-0405-05 | TC | 20pF | | |
| D-1 | TC3 | C05-0405-05 | TC | 20pF | | |
| E-2 | L1 | L40-1511-03 | Ferri inductor | 150μH | | |
| E-3 | L2 | L40-1092-01 | Ferri inductor | 1μH | | |
| E-1 | L3 | L40-1511-03 | Ferri inductor | 150μH | | |
| E-1 | L4 | L40-1092-01 | Ferri inductor | 1μH | | |
| C-1 | L5 | L40-4701-03 | Ferri inductor | 47μH | | |
| B-1 | L6 | L40-4701-03 | Ferri inductor | 47μH | | |
| B-1 | L7 | L40-4701-03 | Ferri inductor | 47μH | | |
| E-3 | RL1 | S51-1509-05 | Lead relay | | | |
| E-3 | RL2 | S51-1509-05 | Lead relay | | | |
| E-1 | RL3 | S51-1509-05 | Lead relay | | | |
| E-1 | RL4 | S51-1509-05 | Lead relay | | | |
| E-2 | Q1 | | TR | 2SA608KNP (F) | | |
| E-2 | Q2 | | TR | 2SA608KNP (F) | | |
| D-2 | Q3 | | TR | 2SA608KNP (F) | | |
| D-3 | Q4 | | TR | 2SC1963 | | |
| D-3 | Q5 | | TR | 2SA884 | | |
| E-2 | Q6 | | TR | 2SC536KNP (F) | | |
| D-3 | Q7 | | TR | 2SA838 (C) | | |
| D-3 | Q8 | | TR | 2SA838 (C) | | |

# PARTS LIST

| Fig. & Index No. | Ref. No. | Parts No. | Description |
|---|---|---|---|
| D-2 | Q9 | | FET 2SK30A (GR) |
| D-2 | Q10 | | FET 2SK68A (M) |
| D-3 | Q11 | | TR 2SC1047 (C) |
| D-3 | Q12 | | TR 2SC1047 (C) |
| D-2 | Q13 | | TR 2SC1047 (C) |
| D-2 | Q14 | | TR 2SC1047 (C) |
| D-3 | Q15 | | TR 2SC1047 (C) |
| D-2 | Q16 | | TR 2SC1047 (C) |
| C-3 | Q17 | | TR 2SC1047 (C) |
| C-2 | Q18 | | TR 2SC1047 (C) |
| C-3 | Q19 | | TR 2SC1047 (C) |
| C-2 | Q20 | | TR 2SC1047 (C) |
| C-3 | Q21 | | TR 2SA838 (C) |
| C-2 | Q22 | | TR 2SA838 (C) |
| C-3 | Q23 | | TR 2SA838 (C) |
| C-2 | Q24 | | TR 2SA838 (C) |
| C-3 | Q25 | | TR 2SA838 (C) |
| C-2 | Q26 | | TR 2SA838 (C) |
| C-3 | Q27 | | TR 2SA838 (C) |
| C-3 | Q28 | | TR 2SA838 (C) |
| C-2 | Q29 | | TR 2SA838 (C) |
| C-2 | Q30 | | TR 2SA838 (C) |
| B-3 | Q31 | | TR 2SC1047 (C) |
| B-3 | Q32 | | TR 2SA838 (C) |
| B-3 | Q33 | | TR 2SC1973 (T) |
| B-3 | Q34 | | TR 2SA684 |
| D-2 | Q35 | | TR 2SC1963 |
| D-1 | Q36 | | TR 2SA884 |
| E-1 | Q37 | | TR 2SC536KNP (F) |
| E-1 | Q38 | | TR 2SA608KNP (F) |
| D-1 | Q39 | | TR 2SA608KNP (F) |
| D-1 | Q40 | | TR 2SA608KNP (F) |
| D-2 | Q41 | | TR 2SA608KNP (F) |
| D-2 | Q42 | | TR 2SA608KNP (F) |
| D-1 | Q43 | | FET 2SK30 (A) (GR) |
| D-1 | Q44 | | FET 2SK68A (M) |
| D-2 | Q45 | | TR 2SC1047 (C) |
| D-2 | Q46 | | TR 2SC1047 (C) |
| D-2 | Q47 | | TR 2SC1047 (C) |
| D-2 | Q48 | | TR 2SC1047 (C) |
| C-2 | Q49 | | TR 2SC1047 (C) |
| C-2 | Q50 | | TR 2SC1047 (C) |
| C-2 | Q51 | | TR 2SC1047 (C) |
| C-1 | Q52 | | TR 2SC1047 (C) |
| D-1 | Q53 | | TR 2SA608KNP (F) |
| D-1 | Q54 | | TR 2SC536KNP (F) |
| C-1 | Q55 | | TR 2SA608KNP (F) |
| C-1 | Q56 | | TR 2SC536KNP (F) |
| C-2 | Q57 | | TR 2SC1047 (C) |
| C-1 | Q58 | | TR 2SC1047 (C) |
| C-2 | Q59 | | TR 2SC1047 (C) |
| C-1 | Q60 | | TR 2SC1047 (C) |
| C-2 | Q61 | | TR 2SA838 (C) |
| C-1 | Q62 | | TR 2SA838 (C) |
| C-2 | Q63 | | TR 2SA838 (C) |
| C-1 | Q64 | | TR 2SA838 (C) |
| C-2 | Q65 | | TR 2SA838 (C) |
| C-1 | Q66 | | TR 2SA838 (C) |
| B-2 | Q67 | | TR 2SA838 (C) |
| B-2 | Q68 | | TR 2SA838 (C) |
| B-1 | Q69 | | TR 2SA838 (C) |
| B-1 | Q70 | | TR 2SA838 (C) |
| B-2 | Q71 | | TR 2SA608KNP (F) |
| B-2 | Q72 | | TR 2SC536KNP (F) |
| B-3 | Q73 | | TR 2SC1047 (C) |
| B-2 | Q74 | | TR 2SC1047 (C) |
| B-3 | Q75 | | TR 2SC1973 (T) |
| B-2 | Q76 | | TR 2SC1973 (T) |
| B-2 | Q77 | | TR 2SC1047 (C) |
| B-1 | Q78 | | TR 2SC1047 (C) |
| B-2 | Q79 | | TR 2SA608KNP (F) |
| B-2 | Q80 | | TR 2SA608KNP (F) |
| B-2 | Q81 | | TR 2SA838 (C) |
| B-1 | Q82 | | TR 2SA838 (C) |
| B-1 | Q83 | | TR 2SC536KNP (F) |
| B-2 | Q84 | | TR 2SC536KNP (F) |
| B-1 | Q85 | | TR 2SA608KNP (F) |
| A-2 | Q86 | | TR 2SA838 (C) |
| B-2 | Q87 | | TR 2SC1047 (C) |
| B-1 | Q88 | | TR 2SC1047 (C) |
| B-1 | Q89 | | TR 2SA838 (C) |
| C-2 | Q90 | | TR 2SC1047 (C) |
| C-2 | Q91 | | TR 2SC1047 (C) |
| C-2 | Q92 | | TR 2SC1047 (C) |
| C-2 | Q93 | | TR 2SC1047 (C) |
| B-2 | Q94 | | TR 2SC1047 (C) |
| B-2 | Q95 | | TR 2SC1047 (C) |
| E-3 | IC1 | | IC CA3102E |
| E-2 | IC2 | | IC CA3102E |
| E-2 | D1 | | Diode DS442X |
| E-2 | D2 | | Diode DS442X |
| D-2 | D3 | | Diode DS442X |
| E-2 | D4 | | Diode WZ-071 |
| E-2 | D5 | | Diode WZ-071 |
| D-2 | D6 | | Diode DS442X |
| D-2 | D7 | | Diode DS442X |
| B-3 | D8 | | Diode WZ-050 |
| B-3 | D9 | | Diode YZ-030 |
| E-1 | D10 | | Diode DS442X |
| E-1 | D11 | | Diode DS442X |
| D-1 | D12 | | Diode DS442X |
| D-1 | D13 | | Diode DS442X |
| E-1 | D14 | | Diode WZ-071 |
| E-1 | D15 | | Diode WZ-071 |
| D-1 | D16 | | Diode DS442X |
| C-3 | D17 | | Diode WZ-071 |
| C-2 | D18 | | Diode DS442X |
| B-2 | D19 | | Diode WZ-071 |
| B-3 | D20 | | Diode DS442X |
| B-2 | D21 | | Diode DS442X |
| B-2 | D22 | | Diode WZ-071 |
| B-2 | D23 | | Diode WZ-071 |
| B-2 | D24 | | Diode DS442X |
| B-2 | D25 | | Diode DS442X |
| B-2 | D26 | | Diode DS442X |
| B-1 | D27 | | Diode DS442X |
| B-1 | D28 | | Diode DS442X |
| B-1 | D29 | | Diode DS442X |
| B-1 | D30 | | Diode DS442X |
| B-2 | D31 | | Diode DS442X |
| B-1 | D32 | | Diode DS442X |
| B-2 | D33 | | Diode DS442X |
| A-2 | TP1 | E40-0211-05 | Pin connector 2P |
| E-2 | P5 | E40-0576-05 | Pin connector 5P |
| E-1 | P6 | E40-0576-05 | Pin connector 5P |
| E-2 | P7 | E40-0676-05 | Pin connector 6P |
| D-1 | P8 | E40-0876-05 | Pin connector 8P |
| C-2 | P9 | E40-0676-05 | Pin connector 6P |
| C-2 | P10 | E40-0476-05 | Pin connector 4P |
| C-2 | P11 | E40-0276-05 | Pin connector 2P |
| C-2 | P12 | E40-0276-05 | Pin connector 2P |
| B-2 | P13 | E40-0576-05 | Pin connector 5P |
| B-2 | P14 | E40-0376-05 | Pin connector 3P |
| C-1 | P15 | E40-0776-05 | Pin connector 7P |
| A-1 | P16 | E40-0576-05 | Pin connector 5P |
| A-2 | P17 | E40-0376-05 | Pin connector 3P |
| B-2 | P18 | E40-0376-05 | Pin connector 3P |
| B-3 | P19 | E40-0376-05 | Pin connector 3P |
| A-2 | P20 | E40-0276-05 | Pin connector 2P |
| | | J25-2942-12 | Printed circuit board |

# PARTS LIST

## VERTICAL OUTPUT AMP UNIT (X73-1430-00)

| Fig. & Index No. | Ref. No. | Parts No. | Description |
|---|---|---|---|
| | R1 | No use | |
| C-2 | R2 | RD14BB2C472J | RD 4.7kΩ |
| C-2 | R3 | RD14BB2C391J | RD 390Ω |
| C-2 | R4 | RD14BB2C473J | RD 47kΩ |
| C-2 | R5 | RD14BB2C223J | RD 22kΩ |
| C-2 | R6 | RD14BB2E161J | RD 160Ω ±5% 1/4W |
| C-3 | R7 | RD14BB2C472J | RD 4.7kΩ |
| C-3 | R8 | RD14BB2C391J | RD 390Ω |
| C-3 | R9 | RD14BB2C473J | RD 47kΩ |
| C-3 | R10 | RD14BB2C223J | RD 22kΩ |
| C-3 | R11 | RD14BB2E161J | RD 160Ω ±5% 1/4W |
| D-3 | R12 | RD14BB2C101J | RD 100Ω |
| D-2 | R13 | RD14BB2C470J | RD 47Ω |
| D-3 | R14 | RD14BB2C470J | RD 47Ω |
| D-2 | R15 | RD14BB2C223J | RD 22kΩ |
| D-3 | R16 | RD14BB2C223J | RD 22kΩ |
| E-2 | R17 | RD14BB2C331J | RD 330Ω |
| E-3 | R18 | RD14BB2C331J | RD 330Ω |
| C-3 | VR1 | R12-3039-05 | VR 10kΩB |
| C-3 | VR2 | R12-3503-05 | VR 22kΩB |
| C-2 | C1 | CC45CH1H100D | CC 10pF ±0.5pF |
| B-3 | C2 | CC45CH1H100D | CC 10pF ±0.5pF |
| C-3 | C3 | CC45CH1H070D | CC 7pF ±0.5pF |
| C-2 | C4 | CC45CH1H010C | CC 1pF ±0.25pF |
| C-2 | C5 | CC45CH1H010C | CC 1pF ±0.25pF |
| C-2 | C6 | CK45B1H103K | CK 0.01μF ±10% |
| C-4 | C7 | CK45B1H103K | CK 0.01μF ±10% |
| C-3 | C8 | CC45CH1H010C | CC 1pF ±0.25pF |
| C-3 | C9 | CC45CH1H010C | CC 1pF ±0.25pF |
| D-4 | C10 | CK45B1H103K | CK 0.01μF ±10% |
| E-2 | C11 | CK45B2H472K | CK 4700pF ±10% 500V |
| E-3 | C12 | CK45B2H472K | CK 4700pF ±10% 500V |
| E-2 | C13 | CK45B2H472K | CK 4700pF ±10% 500V |
| D-4 | C14 | CK45B2H472K | CK 4700pF ±10% 500V |
| E-2 | C15 | CK45B2H472K | CK 4700pF ±10% 500V |
| B-3 | C16 | CE04W1C470M | CE 47μF 16V |
| B-3 | C17 | CE04W1C470M | CE 47μF 16V |
| B-3 | C18 | CE04W1C470M | CE 47μF 16V |
| B-3 | C19 | CE04W2A100M | CE 10μF 100V |
| C-2 | TC1 | C05-0412-05 | TC 20pF |
| C-2 | Q1 | | TR 2SC1973 (T) |
| C-3 | Q2 | | TR 2SC1973 (T) |
| D-2 | Q3 | | TR 2SC805-2 (3) |
| D-5 | Q4 | | TR 2SC805-2 (3) |
| D-2 | Q5 | | TR 2SA923-2 (2, 3) |
| D-5 | Q6 | | TR 2SA923-2 (2, 3) |
| E-2 | D1 | | Diode DS442X |
| E-2 | D2 | | Diode WZ-050 |
| E-3 | D3 | | Diode DS442X |
| E-3 | D4 | | Diode WZ-050 |
| B-2 | P16 | E40-0576-05 | Pin connector 5P |
| B-2 | P17 | E40-0376-05 | Pin connector 3P |
| E-2 | P30 | E23-0512-05 | Terminal 1P |
| E-3 | P31 | E23-0512-05 | Terminal 1P |
| | | F01-0827-04 | Heat sink |
| | | J30-0605-05 | Spacer |
| | | J25-2949-03 | Printed circuit board |

## VERTICAL SWITCH UNIT (X73-1400-00)

| Fig. & Index No. | Ref. No. | Parts No. | Description |
|---|---|---|---|
| E-2 | R1 | RD14BB2C103J | RD 10kΩ |
| E-2 | R2 | RD14BB2C103J | RD 10kΩ |
| E-2 | R3 | RD14BB2C103J | RD 10kΩ |
| D-2 | R4 | RD14BB2C103J | RD 10kΩ |
| D-1 | R5 | RD14BB2C103J | RD 10kΩ |
| E-2 | R6 | RD14BB2C103J | RD 10kΩ |
| E-2 | R7 | RD14BB2C103J | RD 10kΩ |
| B-3 | R8 | RD14BB2C103J | RD 10kΩ |
| E-2 | R9 | RD14BB2C103J | RD 10kΩ |
| B-2 | R10 | RD14BB2C103J | RD 10kΩ |
| B-2 | R11 | RD14BB2C103J | RD 10kΩ |
| B-2 | R12 | RD14BB2C103J | RD 10kΩ |
| B-2 | R13 | RD14BB2C103J | RD 10kΩ |
| B-3 | R14 | RD14BB2C103J | RD 10kΩ |
| B-3 | R15 | RD14BB2C103J | RD 10kΩ |
| B-3 | R16 | RD14BB2C103J | RD 10kΩ |
| B-3 | R17 | RD14BB2C103J | RD 10kΩ |
| C-3 | R18 | RD14BB2C103J | RD 10kΩ |
| E-2 | R19 | RD14BB2C103J | RD 10kΩ |
| D-2 | R20 | RD14BB2C103J | RD 10kΩ |
| D-2 | R21 | RD14BB2C103J | RD 10kΩ |
| C-2 | R22 | RD14BB2C103J | RD 10kΩ |
| C-2 | R23 | RD14BB2C103J | RD 10kΩ |
| C-2 | R24 | RD14BB2C103J | RD 10kΩ |
| B-2 | R25 | RD14BB2C103J | RD 10kΩ |
| A-3 | C1 | CS15E0J470M | Tantalum 47μF 6.3V |
| A-3 | C2 | CK45B1H103K | CK 0.01μF ±10% |
| B-3 | C3 | CK45B1H103K | CK 0.01μF ±10% |
| E-3 | C4 | CK45B1H103K | CK 0.01μF ±10% |
| E-2 | D1 | | Diode 1N60 |
| E-2 | D2 | | Diode 1N60 |
| B-2 | D3 | | Diode 1N60 |
| B-2 | D4 | | Diode 1N60 |
| C-3 | P21 | E40-0376-05 | Pin connector 3P |
| C-3 | P22 | E40-0376-05 | Pin connector 3P |
| B-3 | P23 | E40-0477-05 | Pin connector 4P |
| E-3 | P24 | E10-2661-05 | Pin connector 26P |
| E-1 | S1 | S01-1514-05 | Rotary switch |
| E-2 | S2 | S01-2507-05 | Rotary switch |
| C-1 | S3 | S01-1514-05 | Rotary switch |
| A-2 | S4 | S01-2507-05 | Rotary switch |
| C-2 | S5 | S42-7502-05 | Push switch |
| | | J25-2944-03 | Printed circuit board |

# PARTS LIST

**VERTICAL LOGIC UNIT (X73-1410-00)**

| Fig. & Index No. | Ref. No. | Parts No. | Description |
|---|---|---|---|
| C-4 | R1 | RD14BB2C472J | RD 4.7kΩ |
| C-4 | R2 | RD14BB2C472J | RD 4.7kΩ |
| C-4 | R3 | RD14BB2C103J | RD 10kΩ |
| C-4 | R4 | RD14BB2C103J | RD 10kΩ |
| B-4 | R5 | RD14BB2C103J | RD 10kΩ |
| B-4 | R6 | RD14BB2C103J | RD 10kΩ |
| D-5 | R7 | RD14BB2C471J | RD 470Ω |
| G-1 | R8 | RD14BB2C471J | RD 470Ω |
| G-2 | R9 | RD14BB2C471J | RD 470Ω |
| G-2 | R10 | RD14BB2C471J | RD 470Ω |
| G-2 | R11 | RD14BB2C471J | RD 470Ω |
| G-2 | R12 | RD14BB2C471J | RD 470Ω |
| G-2 | R13 | RD14BB2C471J | RD 470Ω |
| G-2 | R14 | RD14BB2C471J | RD 470Ω |
| G-2 | R15 | RD14BB2C471J | RD 470Ω |
| G-2 | R16 | RD14BB2C471J | RD 470Ω |
| G-2 | R17 | RD14BB2C471J | RD 470Ω |
| G-2 | R18 | RD14BB2C471J | RD 470Ω |
| G-2 | R19 | RD14BB2C471J | RD 470Ω |
| G-3 | R20 | RD14BB2C471J | RD 470Ω |
| G-3 | R21 | RD14BB2C471J | RD 470Ω |
| F-4 | R22 | RD14BB2C471J | RD 470Ω |
| F-4 | R23 | RD14BB2C471J | RD 470Ω |
| E-3 | R24 | RD14BB2C471J | RD 470Ω |
| E-3 | R25 | RD14BB2C471J | RD 470Ω |
| E-3 | R26 | RD14BB2C471J | RD 470Ω |
| E-3 | R27 | RD14BB2C471J | RD 470Ω |
| E-3 | R28 | RD14BB2C471J | RD 470Ω |
| E-3 | R29 | RD14BB2C471J | RD 470Ω |
| E-3 | R30 | RD14BB2C471J | RD 470Ω |
| D-2 | R31 | RD14BB2C471J | RD 470Ω |
| D-2 | R32 | RD14BB2C471J | RD 470Ω |
| D-2 | R33 | RD14BB2C471J | RD 470Ω |
| D-2 | R34 | RD14BB2C471J | RD 470Ω |
| D-2 | R35 | RD14BB2C471J | RD 470Ω |
| D-2 | R36 | RD14BB2C471J | RD 470Ω |
| B-3 | C1 | CK45B1H102K | CK 1000pF ±10% |
| B-3 | C2 | CK45B1H102K | CK 1000pF ±10% |
| D-5 | C3 | CK45B1H102K | CK 1000pF ±10% |
| A-4 | C4 | CK45B1H103K | CK 0.01μF ±10% |
| B-4 | C5 | CE04W1C101M | CE 100μF 16V |
| B-4 | C6 | CE04W1E470M | CE 47μF 25V |
| B-5 | C7 | CE04W1E470M | CE 47μF 25V |
| G-2 | C8 | CK45B1H102K | CK 1000pF ±10% |
| G-3 | C9 | CK45B1H102K | CK 1000pF ±10% |
| F-2 | C10 | CK45B1H102K | CK 1000pF ±10% |
| F-2 | C11 | CK45B1H102K | CK 1000pF ±10% |
| F-2 | C12 | CK45B1H102K | CK 1000pF ±10% |
| F-2 | C13 | CK45B1H102K | CK 1000pF ±10% |
| F-2 | C14 | CK45B1H102K | CK 1000pF ±10% |
| F-2 | C15 | CK45B1H102K | CK 1000pF ±10% |
| F-2 | C16 | CK45B1H102K | CK 1000pF ±10% |
| F-2 | C17 | CK45B1H102K | CK 1000pF ±10% |
| F-2 | C18 | CK45B1H102K | CK 1000pF ±10% |
| F-2 | C19 | CK45B1H102K | CK 1000pF ±10% |
| F-2 | C20 | CK45B1H102K | CK 1000pF ±10% |
| F-3 | C21 | CK45B1H102K | CK 1000pF ±10% |
| F-2 | C22 | CK45B1H102K | CK 1000pF ±10% |
| F-2 | C23 | CK45B1H102K | CK 1000pF ±10% |
| F-2 | C24 | CK45B1H102K | CK 1000pF ±10% |
| E-2 | C25 | CK45B1H102K | CK 1000pF ±10% |
| E-2 | C26 | CK45B1H102K | CK 1000pF ±10% |
| E-2 | C27 | CK45B1H102K | CK 1000pF ±10% |
| E-2 | C28 | CK45B1H102K | CK 1000pF ±10% |
| E-2 | C29 | CK45B1H102K | CK 1000pF ±10% |
| E-2 | C30 | CK45B1H102K | CK 1000pF ±10% |
| E-2 | C31 | CK45B1H102K | CK 1000pF ±10% |
| E-2 | C32 | CK45B1H102K | CK 1000pF ±10% |
| E-2 | C33 | CK45B1H102K | CK 1000pF ±10% |
| E-2 | C34 | CK45B1H102K | CK 1000pF ±10% |
| E-2 | C35 | CK45B1H102K | CK 1000pF ±10% |
| E-2 | C36 | CK45B1H102K | CK 1000pF ±10% |
| C-5 | C37 | CK45B1H103K | CK 0.01μF ±10% |
| E-5 | C38 | CK45B1H103K | CK 0.01μF ±10% |
| F-5 | C39 | CK45B1H103K | CK 0.01μF ±10% |
| B-4 | L1 | L40-1511-03 | Ferri inductor 150μH |
| B-4 | L2 | L40-1011-04 | Ferri inductor 100μH |
| B-5 | L3 | L40-1511-03 | Ferri inductor 150μH |

| Fig. & Index No. | Ref. No. | Parts No. | Description |
|---|---|---|---|
| C-4 | Q1 |  | TR 2SC536KNP (F) |
| C-4 | D1 |  | Diode DS442X |
| C-3 | D2 |  | Diode IN60 |
| C-3 | D3 |  | Diode IN60 |
| C-3 | D4 |  | Diode IN60 |
| C-3 | D5 |  | Diode IN60 |
| C-3 | D6 |  | Diode IN60 |
| B-3 | D7 |  | Diode IN60 |
| C-4 | D8 |  | Diode IN60 |
| C-4 | D9 |  | Diode DS442X |
| C-4 | D10 |  | Diode 1N60 |
| F-3 | IC1 |  | IC MC14051BCP |
| F-4 | IC2 |  | IC MC14051BCP |
| E-4 | IC3 |  | IC SN7407N |
| D-3 | IC4 |  | IC SN74LS42N |
| D-4 | IC5 |  | IC SN74LS42N |
| C-4 | IC6 |  | IC SN74LS00N |
| G-3 | P1 | E40-0576-05 | Pin connector 5P |
| G-5 | P2 | E40-0576-05 | Pin connector 5P |
| E-3 | P3 | E40-0876-05 | Pin connector 8P |
| E-5 | P4 | E40-0776-05 | Pin connector 7P |
| D-3 | P7 | E40-0676-05 | Pin connector 6P |
| D-5 | P8 | E40-0876-05 | Pin connector 8P |
| B-3 | P9 | E40-0676-05 | Pin connector 6P |
| C-3 | P14 | E40-0376-05 | Pin connector 3P |
| A-4 | P15 | E40-0776-05 | Pin connector 7P |
| G-4 | P23 | E40-0476-05 | Pin connector 4P |
| F-2 | P25 | E40-3486-05 | Pin connector 34P |
| C-2 | P26 | E40-3486-05 | Pin connector 34P |
| C-5 | P27 | E40-0676-05 | Pin connector 6P |
| A-4 | P28 | E40-0776-05 | Pin connector 7P |
| A-3 | P29 | E40-3086-05 | Pin connector 30P |
| G-3 | J24 | E10-2662-05 | Pin connector 26P |
|  |  | J25-2945-12 | Printed circuit board |

# PARTS LIST

**SWEEP UNIT (X74-1280-00)**

| Fig. & Index No. | Ref. No. | Parts No. | Description | | | |
|---|---|---|---|---|---|---|
| D-1 | R1 | RD14BB2C221J | RD | 220Ω | | |
| D-1 | R2 | RD14BB2C102J | RD | 1kΩ | | |
| D-1 | R3 | RD14BB2C470J | RD | 47Ω | | |
| D-1 | R4 | RD14BB2C472J | RD | 4.7kΩ | | |
| D-1 | R5 | RD14BB2C470J | RD | 47Ω | | |
| E-1 | R6 | RD14BB2C102J | RD | 1kΩ | | |
| E-1 | R7 | RD14BB2C470J | RD | 47Ω | | |
| E-2 | R8 | RD14BB2C104J | RD | 100kΩ | | |
| E-2 | R9 | RN14BK2E1004F | RN | 1MΩ | ±1% | 1/4W |
| E-2 | R10 | RD14BB2C104J | RD | 100kΩ | | |
| E-2 | R11 | RD14BB2C103J | RD | 10kΩ | | |
| E-2 | R12 | RD14BB2C472J | RD | 4.7kΩ | | |
| E-2 | R13 | RD14BB2C181J | RD | 180Ω | | |
| E-2 | R14 | RD14BB2C181J | RD | 180Ω | | |
| D-2 | R15 | RD14BB2C472J | RD | 4.7kΩ | | |
| D-2 | R16 | RD14BB2C103J | RD | 10kΩ | | |
| D-1 | R17 | RD14BB2C104J | RD | 100kΩ | | |
| D-2 | R18 | RD14BB2C474J | RD | 470kΩ | | |
| D-2 | R19 | RD14BB2C474J | RD | 470kΩ | | |
| D-2 | R20 | RD14BB2C154J | RD | 150kΩ | | |
| D-2 | R21 | RD14BB2C154J | RD | 150kΩ | | |
| D-2 | R22 | RD14BB2C103J | RD | 10kΩ | | |
| D-2 | R23 | RD14BB2C103J | RD | 10kΩ | | |
| E-2 | R24 | RD14BB2C103J | RD | 10kΩ | | |
| E-2 | R25 | RD14BB2C470J | RD | 47Ω | | |
| D-2 | R26 | RD14BB2C470J | RD | 47Ω | | |
| D-2 | R27 | RD14BB2C332J | RD | 3.3kΩ | | |
| E-2 | R28 | RD14BB2C332J | RD | 3.3kΩ | | |
| E-2 | R29 | RD14BB2C470J | RD | 47Ω | | |
| D-2 | R30 | RD14BB2C470J | RD | 47Ω | | |
| E-2 | R31 | RD14BB2C471J | RD | 470Ω | | |
| E-3 | R32 | RD14BB2C101J | RD | 100Ω | | |
| E-2 | R33 | RD14BB2C101J | RD | 100Ω | | |
| E-3 | R34 | RD14BB2C562J | RD | 5.6kΩ | | |
| E-3 | R35 | RD14BB2C472J | RD | 4.7kΩ | | |
| E-3 | R36 | RD14BB2C681J | RD | 680Ω | | |
| D-3 | R37 | RD14BB2C101J | RD | 100Ω | | |
| D-3 | R38 | RD14BB2C101J | RD | 100Ω | | |
| D-3 | R39 | RD14BB2C472J | RD | 4.7kΩ | | |
| D-3 | R40 | RD14BB2C101J | RD | 100Ω | | |
| D-3 | R41 | RD14BB2C101J | RD | 100Ω | | |
| D-3 | R42 | RD14BB2C472J | RD | 4.7kΩ | | |
| D-3 | R43 | RD14BB2C102J | RD | 1kΩ | | |
| E-3 | R44 | RD14BB2C102J | RD | 1kΩ | | |
| E-3 | R45 | RD14BB2C470J | RD | 47Ω | | |
| E-3 | R46 | RD14BB2C222J | RD | 2.2kΩ | | |
| D-3 | R47 | RD14BB2C222J | RD | 2.2kΩ | | |
| D-3 | R48 | RD14BB2C470J | RD | 47Ω | | |
| D-2 | R49 | RD14BB2C331J | RD | 330Ω | | |
| D-2 | R50 | RD14BB2C472J | RD | 4.7kΩ | | |
| D-2 | R51 | RD14BB2C331J | RD | 330Ω | | |
| D-2 | R52 | RD14BB2C472J | RD | 4.7kΩ | | |
| D-3 | R53 | RD14BB2C101J | RD | 100Ω | | |
| D-3 | R54 | RD14BB2C473J | RD | 47kΩ | | |
| D-3 | R55 | RD14BB2C822J | RD | 8.2kΩ | | |
| D-3 | R56 | RD14BB2C183J | RD | 18kΩ | | |
| D-3 | R57 | RD14BB2C103J | RD | 10kΩ | | |
| D-3 | R58 | RD14BB2C103J | RD | 10kΩ | | |
| D-3 | R59 | RD14BB2C102J | RD | 1kΩ | | |
| D-2 | R60 | RD14BB2C474J | RD | 470kΩ | | |
| D-1 | R61 | RD14BB2C331J | RD | 330Ω | | |
| D-1 | R62 | RD14BB2C103J | RD | 10kΩ | | |
| C-1 | R63 | RD14BB2C103J | RD | 10kΩ | | |
| C-1 | R64 | RD14BB2C103J | RD | 10kΩ | | |
| C-1 | R65 | RD14BB2C101J | RD | 100Ω | | |
| C-1 | R66 | RD14BB2C473J | RD | 47kΩ | | |
| C-1 | R67 | RD14BB2C472J | RD | 4.7kΩ | | |
| C-2 | R68 | RD14BB2C472J | RD | 4.7kΩ | | |
| B-2 | R69 | RD14BB2C102J | RD | 1kΩ | | |
| B-2 | R70 | RD14BB2C102J | RD | 1kΩ | | |
| B-2 | R71 | RD14BB2C102J | RD | 1kΩ | | |
| B-2 | R72 | RD14BB2C102J | RD | 1kΩ | | |
| C-1 | R73 | RD14BB2C221J | RD | 220Ω | | |
| B-2 | R74 | RD14BB2C331J | RD | 330Ω | | |
| B-3 | R75 | RD14BB2C682J | RD | 6.8kΩ | | |
| B-2 | R76 | RD14BB2C183J | RD | 18kΩ | | |
| B-2 | R77 | RD14BB2C563J | RD | 56kΩ | | |
| B-3 | R78 | RD14BB2C103J | RD | 10kΩ | | |
| B-3 | R79 | RD14BB2C103J | RD | 10kΩ | | |
| B-3 | R80 | RD14BB2C103J | RD | 10kΩ | | |
| B-3 | R81 | RD14BB2C103J | RD | 10kΩ | | |
| B-3 | R82 | RD14BB2C103J | RD | 10kΩ | | |
| B-3 | R83 | RD14BB2C103J | RD | 10kΩ | | |
| B-3 | R84 | RD14BB2C103J | RD | 10kΩ | | |
| B-3 | R85 | RD14BB2C103J | RD | 10kΩ | | |
| B-3 | R86 | RD14BB2C103J | RD | 10kΩ | | |
| B-3 | R87 | RD14BB2C103J | RD | 10kΩ | | |
| B-3 | R88 | RD14BB2C103J | RD | 10kΩ | | |
| B-3 | R89 | RD14BB2C103J | RD | 10kΩ | | |
| B-2 | R90 | RN14BK2B5602F | RN | 56kΩ | ±1% | 1/8W |
| B-2 | R91 | RD14BB2C273J | RD | 27kΩ | | |
| A-2 | R92 | RN14BK2E1004F | RN | 1MΩ | ±1% | 1/4W |
| A-2 | R93 | RN14BK2B2003F | RN | 200kΩ | ±1% | 1/8W |
| A-2 | R94 | RN14BK2B2003F | RN | 200kΩ | ±1% | 1/8W |
| A-2 | R95 | RN14BK2B2003F | RN | 200kΩ | ±1% | 1/8W |
| A-3 | R96 | RN14BK2B1003F | RN | 100kΩ | ±1% | 1/8W |
| A-3 | R97 | RN14BK2B2002F | RN | 20kΩ | ±1% | 1/8W |
| A-3 | R98 | RN14BK2B2002F | RN | 20kΩ | ±1% | 1/8W |
| A-3 | R99 | RN14BK2B2002F | RN | 20kΩ | ±1% | 1/8W |
| A-3 | R100 | RN14BK2B1002F | RN | 10kΩ | ±1% | 1/8W |
| A-3 | R101 | RN14BK2B3901F | RN | 3.9kΩ | ±1% | 1/8W |
| A-2 | R102 | RD14BB2C473J | RD | 47kΩ | | |
| A-2 | R103 | RD14BB2C473J | RD | 47kΩ | | |
| A-2 | R104 | RD14BB2C473J | RD | 47kΩ | | |
| A-2 | R105 | RD14BB2C473J | RD | 47kΩ | | |
| A-3 | R106 | RD14BB2C473J | RD | 47kΩ | | |
| A-2 | R107 | RD14BB2C473J | RD | 47kΩ | | |
| A-3 | R108 | RD14BB2C473J | RD | 47kΩ | | |
| A-3 | R109 | RD14BB2C473J | RD | 47kΩ | | |
| A-3 | R110 | RD14BB2C473J | RD | 47kΩ | | |
| A-3 | R111 | RD14BB2C473J | RD | 47kΩ | | |
| A-3 | R112 | RD14BB2C473J | RD | 47kΩ | | |
| A-3 | R113 | RD14BB2C473J | RD | 47kΩ | | |
| A-3 | R114 | RD14BB2C473J | RD | 47kΩ | | |
| A-3 | R115 | RD14BB2C473J | RD | 47kΩ | | |
| A-3 | R116 | RD14BB2C473J | RD | 47kΩ | | |
| A-3 | R117 | RD14BB2C473J | RD | 47kΩ | | |
| A-2 | R118 | RD14BB2C472J | RD | 4.7kΩ | | |
| A-2 | R119 | RD14BB2C472J | RD | 4.7kΩ | | |
| B-2 | R120 | RD14BB2C101J | RD | 100Ω | | |
| B-2 | R121 | RD14BB2C273J | RD | 27kΩ | | |
| B-2 | R122 | RD14BB2C470J | RD | 47Ω | | |
| B-2 | R123 | RD14BB2C103J | RD | 10kΩ | | |
| B-2 | R124 | RD14BB2C222J | RD | 2.2kΩ | | |
| B-3 | R125 | RD14BB2C103J | RD | 10kΩ | | |
| B-2 | R126 | RD14BB2C103J | RD | 10kΩ | | |
| B-2 | R127 | RD14BB2C222J | RD | 2.2kΩ | | |
| B-2 | R128 | RD14BB2C472J | RD | 4.7kΩ | | |
| B-1 | R129 | RD14BB2C101J | RD | 100Ω | | |
| C-1 | R130 | RD14BB2C101J | RD | 100Ω | | |
| B-2 | R131 | RD14BB2C332J | RD | 3.3kΩ | | |
| B-2 | R132 | RD14BB2C681J | RD | 680Ω | | |
| A-2 | R133 | RD14BB2C682J | RD | 6.8kΩ | | |
| | R134 | No use | | | | |
| B-2 | R135 | RD14BB2C122J | RD | 1.2kΩ | | |
| A-1 | R136 | RD14BB2C682J | RD | 6.8kΩ | | |
| A-2 | R137 | RD14BB2C682J | RD | 6.8kΩ | | |
| B-1 | R138 | RD14BB2C222J | RD | 2.2kΩ | | |
| B-1 | R139 | RD14BB2C470J | RD | 47Ω | | |
| B-1 | R140 | RD14BB2C392J | RD | 3.9kΩ | | |
| B-1 | R141 | RD14BB2C470J | RD | 47Ω | | |
| B-2 | R142 | RD14BB2C102J | RD | 1kΩ | | |
| B-2 | R143 | RD14BB2C102J | RD | 1kΩ | | |
| A-1 | R144 | RD14BB2C103J | RD | 10kΩ | | |
| A-1 | R145 | RD14BB2C103J | RD | 10kΩ | | |
| A-2 | R146 | RD14BB2C103J | RD | 10kΩ | | |
| A-2 | R147 | RD14BB2C103J | RD | 10kΩ | | |
| C-2 | R148 | RD14BB2C152J | RD | 1.5kΩ | | |
| C-2 | R149 | RD14BB2C152J | RD | 1.5kΩ | | |
| C-2 | R150 | RD14BB2C103J | RD | 10kΩ | | |
| C-2 | R151 | RD14BB2C912J | RD | 9.1kΩ | | |
| C-1 | R152 | RD14BB2C331J | RD | 330Ω | | |
| C-2 | R153 | RD14BB2C560J | RD | 56Ω | | |
| C-1 | R154 | RD14BB2C471J | RD | 470Ω | | |
| A-1 | R155 | RN14BK2B3900F | RN | 390Ω | ±1% | 1/8W |
| A-1 | R156 | RN14BK2B1002F | RN | 10kΩ | ±1% | 1/8W |
| A-2 | R157 | RD14BB2C104J | RD | 100kΩ | | |
| A-2 | R158 | RD14BB2C103J | RD | 10kΩ | | |
| A-2 | R159 | RD14BB2C393J | RD | 39kΩ | | |
| A-2 | R160 | RN14BK2B7502F | RN | 75kΩ | ±1% | 1/8W |

# PARTS LIST

| Fig. & Index No. | Ref. No. | Parts No. | Description | | | |
|---|---|---|---|---|---|---|
| A-2 | R161 | RN14BK2B7502F | RN | 75kΩ | ±1% | 1/8W |
| A-2 | R162 | RD14BB2C393J | RD | 39kΩ | | |
| A-2 | R163 | RD14BB2C103J | RD | 10kΩ | | |
| D-3 | R164 | RD14BB2C472J | RD | 4.7kΩ | | |
| C-2 | R165 | RD14BB2C331J | RD | 330Ω | | |
| A-2 | R166 | RD14BB2C332J | RD | 3.3kΩ | | |
| A-2 | R167 | RD14BB2C332J | RD | 3.3kΩ | | |
| D-1 | VR1 | R12-3052-05 | VR | 47kΩB | | |
| E-3 | VR2 | R12-0502-05 | VR | 100ΩB | | |
| E-2 | VR3 | R12-1029-05 | VR | 1kΩB | | |
| B-2 | VR4 | R12-1033-05 | VR | 2.2kΩB | | |
| B-3 | VR5 | R12-3041-05 | VR | 10kΩB | | |
| B-2 | VR6 | R12-0060-05 | VR | 330ΩB | | |
| A-1 | VR7 | R12-1029-05 | VR | 1kΩB | | |
| A-2 | VR8 | R12-3507-05 | VR | 15kΩB | | |
| D-1 | C1 | CE04W1A470M | CE | 47μF | | 10V |
| D-1 | C2 | CE04W1C470M | CE | 47μF | | 16V |
| E-1 | C3 | CE04BW1H010M | CE | 1μF | | 50V |
| E-1 | C4 | CQ93M1H473K | CQ | 0.047μF | ±10% | |
| E-2 | C5 | CC45CH1H470J | CC | 47pF | ±5% | |
| E-2 | C6 | CK45B1H102K | CK | 1000pF | ±10% | |
| D-2 | C7 | C-90-0298-05 | Semiconductor ceramic | | | |
| | | | | 0.1μF | | 12V |
| D-2 | C8 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-2 | C9 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-2 | C10 | CE04BW1H010M | CE | 1μF | | 50V |
| D-2 | C11 | CE04BW1H010M | CE | 1μF | | 50V |
| D-2 | C12 | CE04BW1H010M | CE | 1μF | | 50V |
| D-2 | C13 | CK45B1H103K | CK | 0.01μF | ±10% | |
| E-3 | C14 | CC45CH1H220J | CC | 22pF | ±5% | |
| E-3 | C15 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-3 | C16 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-3 | C17 | CE04W1C470M | CE | 47μF | | 16V |
| D-3 | C18 | CQ93M1H222K | CQ | 2200pF | ±10% | |
| D-3 | C19 | CE04BW1H010M | CE | 1μF | | 50V |
| D-2 | C20 | CQ93M1H223K | CQ | 0.022μF | ±10% | |
| C-3 | C21 | CQ93M1H223K | CQ | 0.022μF | ±10% | |
| D-1 | C22 | CE04BW1H010M | CE | 1μF | | 50V |
| C-1 | C23 | CE04BW1H010M | CE | 1μF | | 50V |
| C-3 | C24 | CE04W1C100M | CE | 10μF | | 16V |
| C-3 | C25 | CE04BW1H010M | CE | 1μF | | 50V |
| C-3 | C26 | C90-0298-05 | Semiconductor ceramic | | | |
| | | | | 0.1μF | | 12V |
| C-3 | C27 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-3 | C28 | CK45B1H102K | CK | 1000pF | ±10% | |
| C-3 | C29 | CC45CH1H680J | CC | 68pF | ±5% | |
| B-1 | C30 | C91-0547-05 | Polyesterene | 10μF | ±1% | 100V |
| B-2 | C31 | CQ93BP2A104F | CQ (polypropylen) | 0.1μF | ±1% | 100V |
| B-2 | C32 | CQ93M1H222K | CQ | 2200pF | ±10% | |
| B-2 | C33 | CQ93M1H473K | CQ | 0.047μF | ±10% | |
| B-2 | C34 | CQ93BP2A102F | CQ (polypropylen) | 1000pF | ±1% | 100V |
| B-2 | C35 | CE04W1A101M | CE | 100μF | | 10V |
| A-2 | C36 | CK45B1H103K | CK | 0.01μF | ±10% | |
| B-2 | C37 | CE04BW1H010M | CE | 1μF | | 50V |
| B-1 | C38 | CE04W1C101M | CE | 100μF | | 16V |
| B-1 | C39 | CE04BW1H010M | CE | 1μF | | 50V |
| C-2 | C40 | CQ93M1H152K | CQ | 1500pF | ±10% | |
| C-1 | C41 | CQ93M1H152K | CQ | 1500pF | ±10% | |
| C-2 | C42 | CC45SL1H471J | CC | 470pF | ±5% | |
| C-1 | C43 | CC45SL1H221J | CC | 220pF | ±5% | |
| A-2 | C44 | CQ93BP2A103F | CQ (polypropylen) | 0.01μF | ±1% | 100V |
| A-2 | C45 | CQ93BP2A103F | CQ (polypropylen) | 0.01μF | ±1% | 100V |
| E-3 | C46 | CE04W1C470M | CE | 47μF | | 16V |
| E-3 | C47 | CE04W1C470M | CE | 47μF | | 16V |
| C-1 | C48 | CE04W1A470M | CE | 47μF | | 10V2 |
| B-2 | C49 | CE04W1H100M | CE | 10μF | | 50V |
| C-3 | C50 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-3 | C51 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-2 | C52 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-2 | C53 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-2 | C54 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-3 | C55 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-2 | C56 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-2 | C57 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-2 | C58 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-1 | C59 | CK45B1H103K | CK | 0.01μF | ±10% | |
| A-1 | C60 | CE04W1C470M | CE | 47μF | | 16V |
| C-2 | C61 | CK45B1H103K | CK | 0.01μF | ±10% | |

| Fig. & Index No. | Ref. No. | Parts No. | Description | | | |
|---|---|---|---|---|---|---|
| C-2 | C62 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-1 | C63 | CE04W1C470M | CE | 47μF | | 16V |
| C-3 | C64 | CC45SL1H101J | CC | 100pF | ±5% | |
| B-2 | C65 | CC45CH1H180J | CC | 18pF | ±5% | |
| B-3 | C66 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-2 | C67 | CC45CH1H050C | CC | 5pF | ±0.5pF | |
| B-2 | C68 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-1 | C69 | CC45SL1H101J | CC | 100pF | ±5% | |
| A-2 | C70 | CE04W1C220M | CE | 22μF | | 16V |
| D-1 | L1 | L40-4701-03 | Ferri inductor | 47μH | | |
| D-1 | L2 | L40-4701-03 | Ferri inductor | 47μH | | |
| A-1 | L3 | L40-4701-03 | Ferri inductor | 100μH | | |
| E-3 | L4 | L40-4701-03 | Ferri inductor | 47μH | | |
| B-3 | L5 | L40-4701-03 | Ferri inductor | 47μH | | |
| C-1 | L6 | L40-4701-03 | Ferri inductor | 47μH | | |
| E-1 | RL1 | S51-1020-05 | Relay | | | |
| E-1 | RL2 | S51-1020-05 | Relay | | | |
| E-2 | RL3 | S51-1020-05 | Relay | | | |
| E-2 | RL4 | S51-2408-05 | Relay | | | |
| E-2 | RL5 | S51-1020-05 | Relay | | | |
| D-1 | Q1 | | TR | 2SA838 (C) | | |
| D-1 | Q2 | | TR | 2SC1047 (C) | | |
| E-2 | Q3 | | TR | 2SK107 (2,3) | | |
| E-2 | Q4 | | TR | 2SC1047 (C) | | |
| E-2 | Q5 | | TR | 2SC536KNP (F) | | |
| E-2 | Q6 | | TR | 2SA608KNP (F) | | |
| D-2 | Q7 | | TR | 2SA608KNP (C) | | |
| D-2 | Q8 | | FET | 2SK228T (2,3) | | |
| E-2 | Q9 | | TR | 2SC1047 (C) | | |
| D-2 | Q10 | | TR | 2SC1047 (C) | | |
| E-2 | Q11 | | TR | 2SC1047 (C) | | |
| D-2 | Q12 | | TR | 2SC1047 (C) | | |
| E-3 | Q13 | | TR | 2SC536KNP (F) | | |
| E-3 | Q14 | | TR | 2SC1047 (C) | | |
| E-3 | Q15 | | TR | 2SC1047 (C) | | |
| D-3 | Q16 | | TR | 2SC1047 (C) | | |
| D-3 | Q17 | | TR | 2SC1047 (C) | | |
| E-3 | Q18 | | TR | 2SC1047 (C) | | |
| D-3 | Q19 | | TR | 2SC1047 (C) | | |
| D-3 | Q20 | | TR | 2SC536KNP (F) | | |
| D-3 | Q21 | | TR | 2SA608KNP (F) | | |
| D-3 | Q22 | | TR | 2SC536KNP (F) | | |
| C-1 | Q23 | | TR | 2SA608KNP (F) | | |
| C-1 | Q24 | | TR | 2SC536KNP (F) | | |
| B-2 | Q25 | | TR | 2SC1973 (T) | | |
| B-3 | Q26 | | TR | 2SA608KNP (F) | | |
| B-3 | Q27 | | TR | 2SC536KNP (F) | | |
| B-3 | Q28 | | TR | 2SA608KNP (F) | | |
| B-2 | Q29 | | TR | 2SC536KNP (F) | | |
| B-3 | Q30 | | TR | 2SA608KNP (F) | | |
| B-2 | Q31 | | TR | 2SC536KNP (F) | | |
| B-3 | Q32 | | TR | 2SA608KNP (F) | | |
| B-2 | Q33 | | TR | 2SC536KNP (F) | | |
| B-2 | Q34 | | FET | 2SK30A (O) | | |
| B-2 | Q35 | | TR | 2SA608KNP (F) | | |
| A-2 | Q36 | | TR | 2SA608KNP (F) | | |
| A-2 | Q37 | | TR | 2SA608KNP (F) | | |
| A-2 | Q38 | | TR | 2SA608KNP (F) | | |
| A-3 | Q39 | | TR | 2SA608KNP (F) | | |
| A-3 | Q40 | | TR | 2SA608KNP (F) | | |
| A-3 | Q41 | | TR | 2SA608KNP (F) | | |
| A-3 | Q42 | | TR | 2SA608KNP (F) | | |
| A-3 | Q43 | | TR | 2SA608KNP (F) | | |
| A-2 | Q44 | | TR | 2SC536KNP (F) | | |
| A-2 | Q45 | | TR | 2SC536KNP (F) | | |
| A-2 | Q46 | | TR | 2SC536KNP (F) | | |
| A-3 | Q47 | | TR | 2SC536KNP (F) | | |
| A-3 | Q48 | | TR | 2SC536KNP (F) | | |
| A-3 | Q49 | | TR | 2SC536KNP (F) | | |
| A-3 | Q50 | | TR | 2SC536KNP (F) | | |
| A-3 | Q51 | | TR | 2SC536KNP (F) | | |
| B-2 | Q52 | | FET | 2SK30A (O) | | |
| B-2 | Q53 | | TR | 2SC1973 (T) | | |
| B-2 | Q54 | | TR | 2SC536KNP (F) | | |
| B-1 | Q55 | | TR | 2SC1973 (T) | | |
| B-2 | Q56 | | TR | 2SC1047 (C) | | |
| B-2 | Q57 | | TR | 2SC1047 (C) | | |

# PARTS LIST

| Fig. & Index No. | Ref. No. | Parts No. | Description |
|---|---|---|---|
| B-1 | Q58 | | TR 2SC1047 (C) |
| B-2 | Q59 | | TR 2SA608KNP (F) |
| A-2 | Q60 | | TR 2SA608KNP (F) |
| A-2 | Q61 | | TR 2SA608KNP (F) |
| C-2 | Q62 | | TR 2SC1973 (T) |
| A-2 | Q63 | | TR 2SA608KNP (F) |
| A-2 | Q64 | | TR 2SA608KNP (F) |
| A-2 | Q65 | | TR 2SA608KNP (F) |
| D-2 | 1C1 | | IC SN74LS00N |
| D-2 | 1C2 | | IC SN74LS00N |
| D-2 | 1C3 | | IC SN74LS132N |
| D-1 | 1C4 | | IC SN74LS86N |
| D-3 | 1C5 | | IC NJM555D |
| C-2 | 1C6 | | IC SN74LS00N |
| C-2 | 1C7 | | IC SN74LS112AN |
| C-3 | 1C8 | | IC SN74LS00N |
| C-2 | 1C9 | | IC SN74LS00N |
| C-3 | 1C10 | | IC SN7407N |
| E-1 | D1 | | Diode DS442X |
| E-1 | D2 | | Diode DS442X |
| E-3 | D3 | | Diode DS442X |
| E-3 | D4 | | Diode DS442X |
| E-1 | D5 | | Diode DS442X |
| E-2 | D6 | | Diode 1S1544A |
| E-2 | D7 | | Diode 1S1544A |
| D-2 | D8 | | Diode DS442X |
| D-3 | D9 | | Diode DS442X |
| D-3 | D10 | | Diode WZ-061 |
| E-3 | D11 | | Diode WZ-061 |
| D-3 | D12 | | Diode DS442X |
| D-2 | D13 | | Diode 1N60 |
| C-2 | D14 | | Diode DS442X |
| C-2 | D15 | | Diode 1N60 |
| B-2 | D16 | | Diode DS442X |
| B-3 | D17 | | Diode DS442X |
| B-3 | D18 | | Diode DS442X |
| B-3 | D19 | | Diode DS442X |
| B-3 | D20 | | Diode DS442X |
| B-3 | D21 | | Diode DS442X |
| B-3 | D22 | | Diode DS442X |
| B-3 | D23 | | Diode DS442X |
| B-3 | D24 | | Diode DS442X |
| B-2 | D25 | | Diode DS442X |
| A-1 | D26 | | Diode DS442X |
| A-2 | D27 | | Diode DS442X |
| B-1 | D28 | | Diode DS442X |
| B-2 | D29 | | Diode DS442X |
| A-2 | D30 | | Diode 1N60 |
| A-2 | D31 | | Diode DS442X |
| A-2 | D32 | | Diode DS442X |
| B-2 | D33 | | Diode DS442X |
| E-1 | P11 | E40-0276-05 | Pin connector 2P |
| A-1 | P12 | E40-0276-05 | Pin connector 2P |
| E-3 | P39 | E40-1516-05 | Pin connector 15P |
| C-3 | P40 | E40-1516-05 | Pin connector 15P |
| B-3 | P41 | E40-1516-05 | Pin connector 15P |
| A-1 | P48 | E40-0276-05 | Pin connector 2P |
| C-1 | P49 | E40-0276-05 | Pin connector 2P |
| B-1 | P50 | E40-0276-05 | Pin connector 2P |
| C-1 | P51 | E40-0276-05 | Pin connector 2P |
| B-1 | P52 | E40-0376-05 | Pin connector 3P |
| | | J25-2950-12 | Printed circuit board |

## HORIZONTAL OUTPUT AMP UNIT (X74-1290-00)

| Fig. & Index No. | Ref. No. | Parts No. | Description |
|---|---|---|---|
| D-3 | R1 | RD14BB2C103J | RD 10kΩ |
| D-3 | R2 | RD14BB2C103J | RD 10kΩ |
| D-2 | R3 | RD14BB2C103J | RD 10kΩ |
| D-3 | R4 | RD14BB2C912J | RD 9.1kΩ |
| D-3 | R5 | RD14BB2C472J | RD 4.7kΩ |
| D-3 | R6 | RD14BB2C103J | RD 10kΩ |
| D-3 | R7 | RD14BB2C221J | RD 220Ω |
| D-2 | R8 | RD14BB2C912J | RD 9.1kΩ |
| D-3 | R9 | RD14BB2C221J | RD 220Ω |
| D-3 | R10 | RD14BB2C472J | RD 4.7kΩ |
| D-2 | R11 | RD14BB2C101J | RD 100Ω |
| C-2 | R12 | RD14BB2C470J | RD 47Ω |
| C-3 | R13 | RD14BB2C271J | RD 270Ω |
| C-3 | R14 | RD14BB2C271J | RD 270Ω |
| C-2 | R15 | RD14BB2C221J | RD 220Ω |
| C-3 | R16 | RD14BB2C221J | RD 220Ω |
| C-4 | R17 | RD14BB2C222J | RD 2.2kΩ |
| C-4 | R18 | RD14BB2C332J | RD 3.3kΩ |
| C-3 | R19 | RN14BK2E7500F | RN 750Ω ±1% 1/4W |
| C-2 | R20 | RN14BK2E7500F | RN 750Ω ±1% 1/4W |
| C-2 | R21 | RD14BB2C473J | RD 47kΩ |
| C-2 | R22 | RD14BB2B472J | RD 4.7kΩ |
| C-2 | R23 | RD14BB2C470J | RD 47Ω |
| C-3 | R24 | RD14BB2C470J | RD 47Ω |
| C-3 | R25 | RD14BB2C472J | RD 4.7kΩ |
| C-3 | R26 | RD14BB2C473J | RD 47kΩ |
| B-2 | R27 | RD14BB2C332J | RD 3.3kΩ |
| B-3 | R28 | RD14BB2C332J | RD 3.3kΩ |
| B-2 | R29 | RD14BB2C272J | RD 2.7kΩ |
| B-3 | R30 | RD14BB2C272J | RD 2.7kΩ |
| B-2 | R31 | RD14BB2C332J | RD 3.3kΩ |
| B-3 | R32 | RD14BB2C124J | RD 120kΩ |
| B-2 | R33 | RD14BB2C332J | RD 3.3kΩ |
| B-3 | R34 | RD14BB2C124J | RD 120kΩ |
| A-2 | R35 | RD14BB2C331J | RD 330Ω |
| A-3 | R36 | RD14BB2C331J | RD 330Ω |
| D-2 | VR1 | R12-0514-05 | VR 150ΩB |
| C-2 | VR2 | R12-0501-05 | VR 100ΩB |
| E-3 | C1 | CE04W1C470M | CE 47μF 16V |
| E-3 | C2 | CE04W1C470M | CE 47μF 16V |
| E-3 | C3 | CE04W1C470M | CE 47μF 16V |
| E-2 | C4 | CE04W1E470M | CE 47μF 25V |
| E-3 | C5 | CE04W2C3R3M | CE 3.3μF 160V |
| C-2 | C6 | CC45CH2H010C | CC 1pF ±0.25pF 500V |
| C-2 | C7 | CC45CH1H330J | CC 33pF ±5% |
| C-3 | C8 | CC45CH1H470J | CC 47pF +5% |
| C-3 | C9 | CC45CH2H010C | CC 1pF ±0.25pF 500V |
| B-3 | C10 | CK45B1H103K | CK 0.01μF ±10% |
| B-3 | C11 | CK45B2H472K | CK 4700pF ±10% 500V |
| B-2 | C12 | CK45B2H472K | CK 4700pF ±10% 500V |
| A-2 | C13 | CK45B1H103K | CK 0.01μF ±10% |
| A-3 | C14 | CK45B2H472K | CK 4700pF ±10% 500V |
| A-3 | C15 | CK45B1H103K | CK 0.01μF ±10% |
| C-4 | C16 | CK45B1H103K | CK 0.01μF ±10% |
| C-2 | TC1 | C05-0412-05 | TC 20pF |
| D-2 | L1 | L04-2211-03 | Ferri inductor 220μH |
| E-2 | L2 | L04-2211-03 | Ferri inductor 220μH |
| E-2 | L3 | L04-2211-03 | Ferri inductor 220μH |
| D-2 | L4 | L04-2211-03 | Ferri inductor 220μH |
| D-3 | Q1 | | TR 2SA608KNP(F) |
| D-3 | Q2 | | TR 2SC536KNP(F) |
| D-2 | Q3 | | TR 2SA608KNP(F) |
| D-2 | Q4 | | TR 2SC6536NP(F) |
| C-2 | Q5 | | TR 2SC1973(T) |
| C-3 | Q6 | | TR 2SC1973(T) |
| B-2 | Q7 | | TR 2SC1973(T) |
| B-3 | Q8 | | TR 2SC1973(T) |
| B-2 | Q9 | | TR 2SC805A-2(3) |
| B-3 | Q10 | | TR 2SC805A-2(3) |
| B-2 | Q11 | | TR 2SA923-2(2,3) |
| B-3 | Q12 | | TR 2SA923-2(2,3) |
| D-2 | D1 | | Diode DS442X |
| D-2 | D2 | | Diode DS442X |
| D-2 | D3 | | Diode DS442X |

# PARTS LIST

| Fig. & Index No. | Ref. No. | Parts No. | Description |
|---|---|---|---|
| C-3 | D4 | | Diode DS442X |
| C-3 | D5 | | Diode DS442X |
| C-3 | D6 | | Diode DS442X |
| C-3 | D7 | | Diode WZ-071 |
| C-3 | D8 | | Diode DS442X |
| C-2 | D9 | | Diode DS442X |
| C-2 | D10 | | Diode DS442X |
| C-3 | D11 | | Diode DS442X |
| C-3 | D12 | | Diode DS442X |
| E-2 | P42 | E40-0776-05 | Pin connector 7P |
| E-2 | P52 | E40-0376-05 | Pin connector 3P |
| A-3 | P53 | E23-0512-05 | Terminal 1P |
| A-2 | P54 | E23-0512-05 | Terminal 1P |
| | | J30-0605-05 | Spacer |
| | | F01-0827-04 | Heat sink |
| | | J25-2949-03 | Printed circuit board |

## HORIZONTAL SWITCH UNIT (X74-1260-00)

| Fig. & Index No. | Ref. No. | Parts No. | Description |
|---|---|---|---|
| B-1 | R1 | RD14BB2C153J | RD 15kΩ |
| B-1 | R2 | RD14BB2C472J | RD 4.7kΩ |
| B-2 | R3 | RD14BB2C472J | RD 4.7kΩ |
| B-1 | R4 | RD14BB2C623J | RD 62kΩ |
| B-1 | R5 | RD14BB2C273J | RD 27kΩ |
| B-1 | R6 | RD14BB2C223J | RD 22kΩ |
| B-1 | R7 | RD14BB2C273J | RD 27kΩ |
| B-1 | R8 | RD14BB2C223J | RD 22kΩ |
| B-2 | R9 | RD14BB2C273J | RD 27kΩ |
| B-2 | R10 | RD14BB2C223J | RD 22kΩ |
| B-2 | R11 | RD14BB2C273J | RD 27kΩ |
| C-1 | R12 | RD14BB2C103J | RD 10kΩ |
| C-1 | R13 | RD14BB2C103J | RD 10kΩ |
| C-2 | R14 | RD14BB2C103J | RD 10kΩ |
| B-2 | R15 | RD14BB2C103J | RD 10kΩ |
| C-1 | R16 | RD14BB2C103J | RD 10kΩ |
| C-1 | R17 | RD14BB2C103J | RD 10kΩ |
| C-1 | R18 | RD14BB2C103J | RD 10kΩ |
| C-1 | R19 | RD14BB2C103J | RD 10kΩ |
| C-1 | R20 | RD14BB2C103J | RD 10kΩ |
| C-1 | R21 | RD14BB2C103J | RD 10kΩ |
| C-1 | R22 | RD14BB2C103J | RD 10kΩ |
| C-1 | R23 | RD14BB2C103J | RD 10kΩ |
| C-2 | R24 | RD14BB2C103J | RD 10kΩ |
| C-2 | R25 | RD14BB2C103J | RD 10kΩ |
| C-2 | R26 | RD14BB2C103J | RD 10kΩ |
| C-2 | R27 | RD14BB2C103J | RD 10kΩ |
| C-2 | R28 | RD14BB2C103J | RD 10kΩ |
| C-2 | R29 | RD14BB2C103J | RD 10kΩ |
| C-2 | R30 | RD14BB2C103J | RD 10kΩ |
| C-2 | R31 | RD14BB2C103J | RD 10kΩ |
| B-2 | VR1 | R12-4505-05 | VR 50kΩB |
| B-1 | VR2 | R12-4505-05 | VR 50kΩB |
| B-1 | VR3 | R12-4505-05 | VR 50kΩB |
| B-1 | VR4 | R12-3041-05 | VR 10kΩB |
| A-1 | C1 | CE04W1A470M | CE 47μF 10V |
| A-1 | C2 | CK45B1H103K | CK 0.01μF ±10% |
| C-1 | C3 | CK45B1H103K | CK 0.01μF ±10% |
| B-1 | Q1 | | TR 2SC536KNP(F) |
| B-1 | Q2 | | TR 2SC536KNP(F) |
| B-2 | Q3 | | TR 2SC536KNP(F) |
| B-2 | Q4 | | TR 2SC536KNP(F) |
| C-1 | Q5 | | TR 2SC536KNP(F) |
| C-1 | Q6 | | TR 2SC536KNP(F) |
| B-1 | D1 | | Diode DS442X |
| B-1 | D2 | | Diode DS442X |
| B-1 | D3 | | Diode DS442X |
| B-1 | D4 | | Diode DS442X |
| C-2 | D5 | | Diode DS442X |
| A-1 | IC1 | | IC SN74LS42N |
| C-1 | IC2 | | IC SN74LS148N |
| C-2 | IC3 | | IC SN74LS148N |
| C-2 | S1 | S37-2005-05 | Lever switch |
| B-2 | S2 | S01-2508-05 | Rotary switch |
| A-1 | P38 | E40-1716-05 | Pin connector 17P |
| | | J25-2946-05 | Printed circuit board |

# PARTS LIST

## HORIZONTAL LOGIC UNIT (X74-1270-00)

| Fig. & Index No. | Ref. No. | Parts No. | Description |
|---|---|---|---|
| A-1 | R1 | RD14BB2C103J | RD 10kΩ |
| B-1 | R2 | RD14BB2C103J | RD 10kΩ |
| B-1 | R3 | RD14BB2C103J | RD 10kΩ |
| B-1 | R4 | RD14BB2C103J | RD 10kΩ |
| B-1 | R5 | RD14BB2C103J | RD 10kΩ |
| B-1 | R6 | RD14BB2C103J | RD 10kΩ |
| A-1 | R7 | RD14BB2C103J | RD 10kΩ |
| B-1 | R8 | RD14BB2C103J | RD 10kΩ |
| B-1 | R9 | RD14BB2C103J | RD 10kΩ |
| B-1 | R10 | RD14BB2C103J | RD 10kΩ |
| B-1 | R11 | RD14BB2C103J | RD 10kΩ |
| B-1 | R12 | RD14BB2C103J | RD 10kΩ |
| C-2 | R13 | RD14BB2C103J | RD 10kΩ |
| D-2 | R14 | RD14BB2C103J | RD 10kΩ |
| E-2 | R15 | RD14BB2C103J | RD 10kΩ |
| E-2 | R16 | RD14BB2C223J | RD 22kΩ |
| E-2 | R17 | RD14BB2C103J | RD 10kΩ |
| F-2 | R18 | RD14BB2C102J | RD 1kΩ |
| F-2 | R19 | RD14BB2C183J | RD 18kΩ |
| F-2 | R20 | RD14BB2C472J | RD 4.7kΩ |
| F-2 | R21 | RN14BK2E2702F | RN 27kΩ ±1% 1/4W |
| F-2 | R22 | RN14BK2E1102F | RN 11kΩ ±1% 1/4W |
| F-2 | R23 | RD14BB2C103J | RD 10kΩ |
| F-2 | R24 | RD14BB2C102J | RD 1kΩ |
| F-2 | R25 | RD14BB2C221J | RD 220Ω |
| F-2 | C1 | CE04W1C101M | CE 100µF 16V |
| F-2 | C2 | CE04W1C101M | CE 100µF 16V |
| B-2 | C3 | CE04W1C101M | CE 100µF 16V |
| B-1 | C4 | CK45B1H103K | CK 0.01µF ±10% |
| B-2 | C5 | CK45B1H103K | CK 0.01µF ±10% |
| C-1 | C6 | CK45B1H103K | CK 0.01µF ±10% |
| D-1 | C7 | CK45B1H103K | CK 0.01µF ±10% |
| D-2 | C8 | CK45B1H103K | CK 0.01µF ±10% |
| E-1 | C9 | CK45B1H103K | CK 0.01µF ±10% |
| E-2 | C10 | CK45B1H103K | CK 0.01µF ±10% |
| F-2 | C11 | CE04W1C470M | CE 47µF 16V |
| G-2 | C12 | CE04W1H010M | CE 1µF 50V |
| F-2 | L1 | L40-1011-04 | Ferri inductor 10µH |
| F-2 | Q1 |  | TR 2SC536KNP(F) |
| F-2 | Q2 |  | TR 2SC536KNP(F) |
| F-2 | Q3 |  | TR 2SC536KNP(F) |
| F-2 | Q4 |  | TR 2SC2910(S,T) |
| C-2 | D1 |  | Diode 1N60 |
| C-2 | D2 |  | Diode 1N60 |
| C-2 | D3 |  | Diode 1N60 |
| C-2 | D4 |  | Diode 1N60 |
| E-2 | D5 |  | Diode 1N60 |
| E-2 | D6 |  | Diode 1N60 |
| G-2 | D7 |  | Diode DS442X |
| F-2 | D8 |  | Diode DS442X |
| C-1 | IC1 |  | IC SN74LS42N |
| C-2 | IC2 |  | IC SN7407N |
| C-1 | IC3 |  | IC SN74LS42N |
| C-2 | IC4 |  | IC SN74LS00N |
| D-1 | IC5 |  | IC SN74LS00N |
| D-2 | IC6 |  | IC SN74LS10N |
| D-1 | IC7 |  | IC SN74LS86N |
| D-2 | IC8 |  | IC SN74LS00N |
| E-1 | IC9 |  | IC SN74LS112AN |
| E-2 | IC10 |  | IC SN74LS42N |
| E-2 | IC11 |  | IC SN74LS42N |
| F-2 | IC12 |  | IC ON3101 |
| F-2 | IC13 |  | IC TLP521-1 |
| A-1 | S1 | S37-2005-05 | Lever switch |
| A-1 | S2 | S37-2005-05 | Lever switch |
| A-2 | S3 | S33-2501-05 | Lever switch |
| A-2 | S4 | S33-2501-05 | Lever switch |
| D-2 | P10 | E40-0476-05 | Pin connector 4P |
| E-2 | P13 | E40-0576-05 | Pin connector 5P |
| D-2 | P27 | E40-0676-05 | Pin connector 6P |
| D-1 | P32 | E10-0061-05 | Pin connector 100P |
| F-2 | P33 | E40-0276-05 | Pin connector 2P |
| G-1 | P34 | E40-0377-05 | Pin connector 3P |
| B-2 | P37 | E40-0376-05 | Pin connector 3P |
| B-2 | P38 | E40-1711-05 | Pin connector 17P |
| C-2 | P39 | E40-1511-05 | Pin connector 15P |
| D-2 | P40 | E40-1511-05 | Pin connector 15P |
| E-2 | P41 | E40-1511-05 | Pin connector 15P |
| F-1 | P42 | E40-0776-05 | Pin connector 7P |
| F-2 | P43 | E40-0876-05 | Pin connector 8P |
| G-1 | P44 | E40-2686-05 | Pin connector 26P |
| F-1 | P45 | E40-2085-05 | Pin connector 20P |
|  |  | J25-2947-12 | Printed circuit board |

# PARTS LIST

## POWER BLANKING UNIT (X68-1350-00)

| Fig. & Index No. | Ref. No. | Parts No. | Description | | | |
|---|---|---|---|---|---|---|
| B-5 | R1 | RN14BK2B5102F | RN | 51kF | ±1% | 1/8W |
| B-5 | R2 | RN14BK2B5101F | RN | 5.1kΩ | ±1% | 1/8W |
| A-4 | R3 | RD14BB2C102J | RD | 1kΩ | | |
| B-4 | R4 | RD14BB2C562J | RD | 5.6kΩ | | |
| B-4 | R5 | RD14BB2C101J | RD | 100Ω | | |
| B-4 | R6 | RD14BB2C102J | RD | 1kΩ | | |
| C-4 | R7 | RN14BK2B1303F | RN | 130kΩ | ±1% | 1/8W |
| B-4 | R8 | RN14BK2B5601F | RN | 5.6kΩ | ±1% | 1/8W |
| B-4 | R9 | RD14BB2C221J | RD | 220Ω | | |
| C-3 | R10 | RD14BB2C392J | RD | 3.9kΩ | | |
| C-4 | R11 | RN14BK2B5101F | RN | 5.1kΩ | ±1% | 1/8W |
| C-4 | R12 | RN14BK2B5101F | RN | 5.1kΩ | ±1% | 1/8W |
| B-3 | R13 | RD14BB2C331J | RD | 330Ω | | |
| C-3 | R14 | RD14BB2C392J | RD | 3.9kΩ | | |
| C-3 | R15 | RN14BK2B1301F | RN | 1.3kΩ | ±1% | 1/8W |
| C-3 | R16 | RN14BK2B3901F | RN | 3.9kΩ | ±1% | 1/8W |
| B-4 | R17 | RD14BB2C561J | RD | 560Ω | | |
| C-4 | R18 | RD14BB2C222J | RD | 2.2kΩ | | |
| A-5 | R19 | RD14BB2E100J | RD | 10Ω | ±5% | 1/4W |
| B-5 | R20 | RN14BK2B1302F | RN | 13kΩ | ±1% | 1/8W |
| B-5 | R21 | RN14BK2B8201F | RN | 8.2kΩ | ±1% | 1/8W |
| F-5 | R22 | RD14BB2C221J | RD | 220Ω | | |
| B-2 | R23 | RD14BB2E101J | RD | 100Ω | ±5% | 1/4W |
| E-3 | R24 | RD14BB2C332J | RD | 3.3kΩ | | |
| E-3 | R25 | RD14BB2C561J | RD | 560Ω | | |
| E-3 | R26 | RD14BB2C124J | RD | 120kΩ | | |
| E-3 | R27 | RD14BB2C124J | RD | 120kΩ | | |
| E-3 | R28 | RD14BB2C470J | RD | 47Ω | | |
| E-4 | R29 | RD14BB2C221J | RD | 220Ω | | |
| E-4 | R30 | RD14BB2C823J | RD | 82kΩ | | |
| E-4 | R31 | RD14BB2C562J | RD | 5.6kΩ | | |
| D-3 | R32 | RD14BB2C124J | RD | 120kΩ | | |
| D-3 | R33 | RD14BB2C562J | RD | 5.6kΩ | | |
| D-3 | R34 | RD14BB2C561J | RD | 560Ω | | |
| D-4 | R35 | RD14BB2C103J | RD | 10kΩ | | |
| E-3 | R36 | RD14BB2C753J | RD | 75kΩ | | |
| D-4 | R37 | RD14BB2C122J | RD | 1.2kΩ | | |
| E-3 | R38 | RD14BB2C470J | RD | 47Ω | | |
| C-3 | R39 | RD14BB2C683J | RD | 68kΩ | | |
| C-3 | R40 | RD14BB2C683J | RD | 68kΩ | | |
| C-2 | R41 | RD14BB2C102J | RD | 1kΩ | | |
| C-3 | R42 | RD14BB2C102J | RD | 1kΩ | | |
| C-3 | R43 | RD14BB2C103J | RD | 10kΩ | | |
| C-3 | R44 | RD14BB2C102J | RD | 1kΩ | | |
| E-1 | R45 | R92-0755-05 | Metal graze | 3MΩ | ±5% | 1/2W |
| D-1 | R46 | R92-0756-05 | Metal graze | 47MΩ | ±5% | 1/2W |
| C-2 | R47 | RD14BB2C683J | RD | 68kΩ | | |
| C-2 | R48 | R92-0793-05 | Metal graze | 15MΩ | ±5% | 1//2W |
| F-1 | R49 | RC05GF2H565J | RC | 5.6MΩ | ±5% | 1/2W |
| F-2 | R50 | RC05GF2H156J | RC | 15MΩ | ±5% | 1/2W |
| B-1 | R51 | RD14BB2C103J | RD | 10kΩ | | |
| B-1 | R52 | RD14BB2C103J | RD | 10kΩ | | |
| B-1 | R53 | RD14BB2C102J | RD | 1kΩ | | |
| B-1 | R54 | RD14BB2C472J | RD | 4.7kΩ | | |
| A-4 | R55 | RD14BB2C331J | RD | 330Ω | | |
| D-4 | R56 | RD14BB2C332J | RD | 3.3kΩ | | |
| D-4 | R57 | RD14BB2C332J | RD | 3.3kΩ | | |
| D-4 | R58 | RD14BB2C682J | RD | 6.8kΩ | | |
| E-4 | R59 | RD14BB2C221J | RD | 220Ω | | |
| E-4 | R60 | RD14BB2C472J | RD | 4.7kΩ | | |
| E-4 | R61 | RD14BB2E101J | RD | 100Ω | ±5% | 1/4W |
| E-4 | R62 | RD14BB2C332J | RD | 3.3kΩ | | |
| E-4 | R63 | RD14BB2C152J | RD | 1.5kΩ | | |
| F-5 | R64 | RD14BB2C102J | RD | 1kΩ | | |
| F-5 | R65 | RD14BB2C562J | RD | 5.6kΩ | | |
| E-5 | R66 | RD14BB2C510J | RD | 51Ω | | |
| E-5 | R67 | RD14BB2C222J | RD | 2.2kΩ | | |
| E-5 | R68 | RD14BB2C471J | RD | 470Ω | | |
| A-3 | R69 | RD14BB2C562J | RD | 5.6kΩ | | |
| B-2 | R70 | RD14BB2C102J | RD | 1kΩ | | |
| D-4 | VR1 | R12-3507-05 | VR | 15kΩB | | |
| E-4 | VR2 | R12-3507-05 | VR | 15kΩB | | |
| C-2 | VR3 | R12-3042-05 | VR | 47kΩB | | |
| G-1 | VR4 | R05-8001-05 | VR | 3MΩB | | |
| A-3 | VR5 | R12-5501-05 | VR | 150kΩB | | |
| C-5 | C1 | CK45B1H103K | CK | 0.01μF | ±10% | |
| B-5 | C2 | CE04W1V100M | CE | 10μF | | 35V |
| C-5 | C3 | CE04W1J330M | CE | 33μF | | 63V |
| B-5 | C4 | CE04W2C3R3M | CE | 3.3μF | | 160V |
| C-5 | C5 | CE04W2C3R3M | CE | 3.3μF | | 160V |
| C-4 | C6 | CE04W1C330M | CE | 33μF | | 16V |
| C-3 | C7 | C91-0549-05 | Tantalum | 1μF | | 35V |
| C-4 | C8 | CE04W1E101M | CE | 100μF | | 25V |
| C-3 | C9 | CE04W1E101M | CE | 100μF | | 25V |
| C-4 | C10 | CE04W1A221M | CE | 220μF | | 10V |
| B-5 | C11 | CE04W1V100M | CE | 10μF | | 35V |
| A-5 | C12 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-5 | C13 | CE04W1V470M | CE | 47μF | | 35V |
| B-3 | C14 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-3 | C15 | CK45B2H472K | CK | 4700pF | ±10% | 500V |
| E-3 | C16 | CK45B2H472K | CK | 4700pF | ±10% | 500V |
| E-4 | C17 | CC45CH2H010C | CC | 1pF | ±0.25pF | 500V |
| E-3 | C18 | CK45B1H103K | CK | 0.01μF | ±10% | |
| C-3 | C19 | CE04W2C3R3M | CE | 3.3μF | | 160V |
| D-3 | C20 | CK45B2H472K | CK | 4700pF | ±10% | 500V |
| D-3 | C21 | CK45B1H103K | CK | 0.01μF | ±10% | |
| E-3 | C22 | CC45CH2H010C | CC | 1pF | ±0.25pF | 500V |
| E-2 | C23 | CK45E3D103P | CK | 0.01μF | +100%<br>−0% | 2000V |
| E-2 | C24 | CK45E3D103P | CK | 0.01μF | +100%<br>−0% | 2000V |
| D-2 | C25 | CK45E3D103P | CK | 0.01μF | +100%<br>−0% | 2000V |
| D-2 | C26 | CK45E3D103P | CK | 0.01μF | +100%<br>−0% | 2000V |
| C-2 | C27 | CK45B1H472K | CK | 4700pF | ±10% | |
| C-2 | C28 | CE04W1E470M | CE | 47μF | | 25V |
| C-1 | C29 | CK45E3D102P | CK | 1000pF | +100%<br>−0% | 2000V |
| F-1 | C30 | CK45E3D102P | CK | 1000pF | +100%<br>−0% | 2000V |
| F-1 | C31 | CK45E3D103P | CK | 0.01μF | +100%<br>−0% | 2000V |
| D-1 | C32 | CK45E3D103P | CK | 0.01μF | +100%<br>−0% | 2000V |
| C-1 | C33 | CQ93M1H154K | CQ | 0.15μF | ±10% | |
| C-2 | C34 | CK45B1H472K | CK | 4700pF | ±10% | |
| C-2 | C35 | CE04W1E470M | CE | 47μF | | 25V |
| C-1 | C36 | CK45B1H103K | CK | 0.01μF | ±10% | |
| B-2 | C37 | CK45B1H103K | CK | 0.01μF | ±10% | |
| B-1 | C38 | CQ93M1H472K | CQ | 4700pF | ±10% | |
| B-1 | C39 | CK45B1H103K | CK | 0.01μF | ±10% | |
| B-1 | C40 | CE04W1E470M | CE | 47μF | | 25V |
| B-2 | C41 | CE04W1E470M | CE | 47μF | | 25V |
| E-4 | C42 | CC45CH1H100D | CC | 10pF | ±0.5pF | |
| E-5 | C43 | CK45B1H472K | CK | 4700pF | ±10% | |
| F-5 | C44 | C91-0549-05 | Tantalum | 1μF | | 35V |
| E-5 | C45 | CC45CH1H680J | CC | 68pF | ±5% | |
| B-2 | C46 | CK45B2H222K | CK | 2200pF | ±10% | 500V |
| D-4 | C47 | CE04W1E101M | CE | 100μF | | 25V |
| D-4 | C48 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-4 | C49 | CE04W1A221M | CE | 220μF | | 10V |
| D-4 | C50 | CK45B1H103K | CK | 0.01μF | ±10% | |
| D-5 | TC1 | C05-0405-05 | TC | 20pF | | |
| E-4 | TC2 | C05-0405-05 | TC | 20pF | | |
| E-4 | TC3 | C05-0403-05 | TC | 6pF | | |
| C-5 | L1 | L40-1011-04 | Ferri-inductor | 100μH | | |
| C-3 | L2 | L40-1001-01 | Ferri-inductor | 10μH | | |
| C-5 | L3 | L40-1011-04 | Ferri-inductor | 100μH | | |
| C-4 | L4 | L40-1011-04 | Ferri-inductor | 100μH | | |
| C-4 | L5 | L40-1011-04 | Ferri-inductor | 100μH | | |
| C-4 | L6 | L40-1011-04 | Ferri-inductor | 100μH | | |
| B-2 | L7 | L40-1011-03 | Ferri-inductor | 100μH | | |
| B-1 | L8 | L40-1011-04 | Ferri-inductor | 100μH | | |
| B-2 | L9 | L40-1011-04 | Ferri-inductor | 100μH | | |
| D-1 | NL1 | | Neon lamp NE-2B | | | |
| D-1 | NL2 | | Neon lamp NE-2B | | | |
| E-1 | NL3 | | Neon lamp NE-2B | | | |
| E-1 | NL4 | | Neon lamp NE-2B | | | |
| B-4 | Q1 | | TR | 2SC1913 (Q, R) | | |
| B-4 | Q2 | | TR | 2SC1505 (L) | | |
| C-4 | Q3 | | TR | 2SB633 (E) | | |
| C-3 | Q4 | | TR | 2SD613 (E) | | |
| C-4 | Q5 | | TR | 2SB633 (E) | | |

# PARTS LIST

## CPU UNIT(X81-1050-00)

| Fig. & Index No. | Ref. No. | Parts No. | Description |
|---|---|---|---|
| B-5 | Q6 | | TR 2SC1505 (L) |
| B-5 | Q7 | | TR 2SC536KNP (F) |
| B-3 | Q8 | | TR 2SC536KNP (F) |
| B-3 | Q9 | | TR 2SA608KNP (F) |
| E-3 | Q10 | | TR 2SA1208 (S, T) |
| E-3 | Q11 | | TR 2SC2910 (S, T) |
| D-3 | Q12 | | TR 2SA923-2-(2, 3) |
| D-4 | Q13 | | TR 2SC1215 (T, S) |
| E-3 | Q14 | | TR 2SC805A-2-(2, 3) |
| C-2 | Q15 | | TR 2SC2910 (S, T) |
| C-3 | Q16 | | TR 2SC2910 (S, T) |
| B-1 | Q17 | | TR 2SC536KNP (F) |
| C-1 | Q18 | | TR 2SC536KNP (F) |
| B-1 | Q19 | | TR 2SA608KNP (F) |
| C-1 | Q20 | | FET 2SK19-BL |
| B-1 | Q21 | | TR 2SD613 (E) |
| D-5 | Q22 | | TR 2SC1047 (C) |
| E-4 | Q23 | | TR 2SC1215 (T, S) |
| E-5 | Q24 | | TR 2SC1215 (T, S) |
| E-4 | IC1 | | IC NJM4558D |
| B-3 | IC2 | | IC NJM4558D |
| B-4 | D1 | | Diode DS442X |
| B-3 | D2 | | Diode WZ-120 |
| B-3 | D3 | | Diode WZ-120 |
| E-4 | D4 | | Diode WZ-120 |
| E-4 | D5 | | Diode DS442X |
| D-5 | D6 | | Diode WZ-090 |
| D-3 | D7 | | Diode 1SS83 |
| E-3 | D8 | | Diode 1SS83 |
| D-2 | D9 | | Diode W06C |
| D-1 | D10 | | Diode W06C |
| F-1 | D11 | | Diode W06C |
| F-1 | D12 | | Diode W06C |
| B-1 | D13 | | Diode DS442X |
| C-1 | D14 | | Diode DS442X |
| C-1 | D15 | | Diode WZ-090 |
| B-1 | D16 | | Diode DS442X |
| D-5 | P28 | E40-0776-05 | Pin connector 7P |
| D-5 | P43 | E40-0876-05 | Pin connector 8P |
| E-5 | P49 | E40-0276-05 | Pin connector 2P |
| F-5 | P55 | E40-0376-05 | Pin connector 3P |
| F-5 | P56 | E40-0276-05 | Pin connector 2P |
| A-5 | P57 | E40-0746-05 | Pin connector 7P |
| C-2 | P58 | E40-0276-05 | Pin connector 2P |
| A-2 | P59 | E40-0276-05 | Pin connector 2P |
| D-1 | P60 | E40-0332-05 | Pin connector 3P |
| A-1 | P61 | E40-0703-05 | Pin connector 7P |
| D-5 | P62 | E40-0276-05 | Pin connector 2P |
| C-3 | P64 | E40-0376-05 | Pin connector 3P |
| | | F01-0826-05 | Heat sink |
| | | F02-0503-04 | Heat sink |
| | | F20-0516-05 | Rubber sheet |
| | | J21-2930-04 | Bracket for VR |
| | | J30-0605-05 | Spacer for TR |
| | | J25-2948-12 | Printed circuit board |
| | S1 | S59-2503-05 | Power switch |

| Fig. & Index No. | Ref. No. | Parts No. | Description |
|---|---|---|---|
| B-1 | R1 | RD14BB2C272J | RD 2.7kΩ |
| B-1 | R2 | RD14BB2C681J | RD 680Ω |
| B-1 | R3 | RD14BB2C472J | RD 4.7kΩ |
| B-2 | R4 | R90-0608-05 | Resistor alay 4.7kΩ×5 |
| B-1 | R5 | RD14BB2C331J | RD 330Ω |
| B-1 | R6 | RD14BB2C332J | RD 3.3kΩ |
| B-3 | R7 | RD14BB2C472J | RD 4.7kΩ |
| B-1 | R8 | RD14BB2C222J | RD 2.2kΩ |
| B-1 | R9 | RD14BB2C474J | RD 470kΩ |
| B-1 | R10 | RD14BB2C682J | RD 6.8kΩ |
| B-1 | R11 | RD14BB2C102J | RD 1kΩ |
| B-1 | R12 | RD14BB2C391J | RD 390Ω |
| C-1 | R13 | RD14BB2C472J | RD 4.7kΩ |
| C-1 | R14 | RD14BB2C122J | RD 1.2kΩ |
| A-2 | R15 | R90-0609-05 | Resistor alay 4.7kΩ×8 |
| C-1 | R16 | RD14BB2C221J | RD 220Ω |
| C-1 | R17 | RD14BB2C472J | RD 4.7kΩ |
| C-1 | R18 | RD14BB2C472J | RD 4.7kΩ |
| D-1 | R19 | RD14BB2C472J | RD 4.7kΩ |
| D-2 | R20 | RD14BB2C472J | RD 4.7kΩ |
| D-2 | R21 | RD14BB2C563J | RD 56kΩ |
| C-1 | R22 | RD14BB2C101J | RD 100Ω |
| B-1 | R23 | RD14BB2C103J | RD 10kΩ |
| B-1 | R24 | RD14BB2C103J | RD 10kΩ |
| B-1 | VR1 | R12-1513-05 | VR 2kΩB |
| B-1 | VR2 | R12-1512-05 | VR 1kΩB |
| B-2 | C1 | CE04W1A470M | CE 47μF 10V |
| B-3 | C2 | CK45B1H103K | CK 0.01μF ±10% |
| B-3 | C3 | CK45B1H103K | CK 0.01μF ±10% |
| A-2 | C4 | C91-0549-05 | Tantalum 1μF 35V |
| C-1 | C5 | C90-0298-05 | Semi conductor ceramic<br>0.1μF 12V |
| C-1 | C6 | C91-0549-05 | Tantalum 1μF 35V |
| C-2 | C7 | C91-0549-05 | Tantalum 1μF 35V |
| D-2 | C8 | CK45B1H103K | CK 0.01μF ±10% |
| D-1 | C9 | CE04W1A470M | CE 47μF 10V |
| D-2 | C10 | CE04W1A470M | CE 47μF 10V |
| B-1 | Q1 | | TR 2SC945(Q) |
| C-1 | Q2 | | TR 2SC536KNP(F) |
| C-1 | Q3 | | TR 2SC536KNP(F) |
| B-1 | Q4 | | TR 2SC536KNP(F) |
| B-1 | D1 | | Diode 1S1544A |
| B-1 | D2 | | Diode 1S1544A |
| B-1 | D3 | | Diode WZ-032 |
| B-1 | D4 | | Diode DS442X |
| B-1 | D5 | | Diode DS442X |
| C-1 | D6 | | Diode WZ-032 |
| D-2 | D7 | | Diode DS442X |
| B-3 | IC1 | | IC M74LS32P |
| B-2 | IC2 | | IC MB8414EM |
| B-3 | IC3 | | IC M74LS138P |
| B-1 | IC4 | | IC TL061CP |
| B-2 | IC5 | | IC MB8414EM |
| C-3 | IC6 | | IC MB8516EC |
| C-1 | IC7 | | IC M74LS00P |
| C-3 | IC8 | | IC M74LS373P |
| A-2 | IC9 | | IC MB74LS245M |
| C-1 | IC10 | | IC M74LS367AP |
| C-2 | IC11 | | IC μPD8085AC |
| | X1 | L78-0102-05 | Ceramic resonator |
| | | E02-0132-05 | IC socket |
| | | E02-0133-05 | IC socket |
| | | E02-2401-05 | IC socket |
| A-2 | P35 | E10-4061-05 | Pin connector 40P |
| A-2 | P36 | E40-3085-05 | Pin connector 30P |
| | | J25-2931-12 | Printed circuit board |

# PARTS LIST

**I/O UNIT (X81-1060-00)**

| Fig. & Index No. | Ref. No. | Parts No. | Description |
|---|---|---|---|
| B-1 | R1 | RD14BB2C391J | RD 390Ω |
| B-2 | R2 | RD14BB2C391J | RD 390Ω |
| B-2 | R3 | RD14BB2C391J | RD 390Ω |
| B-2 | R4 | RD14BB2C391J | RD 390Ω |
| B-1 | R5 | RD14BB2C391J | RD 390Ω |
| B-1 | R6 | RD14BB2C391J | RD 390Ω |
| B-2 | R7 | RD14BB2C391J | RD 390Ω |
| B-2 | R8 | RD14BB2C391J | RD 390Ω |
| B-2 | R9 | RD14BB2C391J | RD 390Ω |
| B-2 | R10 | RD14BB2C391J | RD 390Ω |
| B-1 | R11 | RD14BB2C391J | RD 390Ω |
| B-1 | R12 | RD14BB2C391J | RD 390Ω |
| B-1 | R13 | RD14BB2C391J | RD 390Ω |
| B-1 | R14 | RD14BB2C391J | RD 390Ω |
| B-1 | R15 | RD14BB2C103J | RD 10kΩ |
| B-1 | R16 | RD14BB2C223J | RD 22kΩ |
| B-2 | R17 | RD14BB2C223J | RD 22kΩ |
| B-2 | R18 | RD14BB2C103J | RD 10kΩ |
| A-1 | R19 | RD14BB2C391J | RD 390Ω |
| A-1 | R20 | RD14BB2C391J | RD 390Ω |
| B-2 | C1 | CK45B1H103K | CK 0.01μF ±10% |
| C-2 | C2 | CK45B1H103K | CK 0.01μF ±10% |
| C-1 | C3 | CK45B1H103K | CK 0.01μF ±10% |
| C-2 | C4 | CK45B1H103K | CK 0.01μF ±10% |
| D-1 | C5 | CK45B1H103K | CK 0.01μF ±10% |
| D-2 | C6 | CK45B1H103K | CK 0.01μF ±10% |
| E-2 | C7 | CK45B1H103K | CK 0.01μF ±10% |
| E-1 | C8 | CK45B1H103K | CK 0.01μF ±10% |
| F-2 | C9 | CK45B1H103K | CK 0.01μF ±10% |
| B-1 | C10 | C91-0549-05 | Tantalum 1μF 35V |
| B-2 | C11 | C91-0549-05 | Tantalum 1μF 35V |
| E-1 | C12 | C91-0549-05 | Tantalum 1μF 35V |
| E-1 | C13 | CE02W1A470M | CE 47μF 10V |
| E-2 | C14 | CE04W1A470M | CE 47μF 10V |
| B-1 | Q1 | | TR 2SC536KNP (F) |
| B-2 | Q2 | | TR 2SC536KNP (F) |
| A-1 | D1 | | Diode TLR320 |
| A-1 | D2 | | Diode PG4133SX |
| A-1 | D3 | | Diode GD-4-505RD |
| B-1 | IC1 | | IC TC4511BP |
| B-2 | IC2 | | IC TC4511BP |
| B-1 | IC3 | | IC M74LS373P |
| B-2 | IC4 | | IC M74LS373P |
| C-1 | IC5 | | IC M74LS373P |
| C-2 | IC6 | | IC M74LS373P |
| C-1 | IC7 | | IC M74LS373P |
| C-2 | IC8 | | IC M74LS373P |
| C-1 | IC9 | | IC M74LS373P |
| C-2 | IC10 | | IC M74LS373P |
| D-1 | IC11 | | IC M74LS374P |
| D-2 | IC12 | | IC M74LS374P |
| D-1 | IC13 | | IC M74LS374P |
| D-2 | IC14 | | IC M74LS374P |
| D-1 | IC15 | | IC M74LS374P |
| D-2 | IC16 | | IC M74LS374P |
| E-1 | IC17 | | IC M74LS374P |
| E-2 | IC18 | | IC M74LS374P |
| E-1 | IC19 | | IC M74LS138P |
| E-1 | IC20 | | IC M74LS02P |
| E-2 | IC21 | | IC M74LS374P |
| E-1 | IC22 | | IC M74LS138P |
| E-1 | IC23 | | IC M74LS196P |
| E-2 | IC24 | | IC M74LS126P |
| C-1 | P25 | E40-3486-05 | Pin connector 34P |
| D-1 | P26 | E40-3486-05 | Pin connector 34P |
| C-2 | P32 | E10-0061-05 | Pin connector 100P |
| F-1 | J35 | E10-4062-05 | Connector 40P |
| | | J25-2933-12 | Printed circuit board |

# PARTS LIST

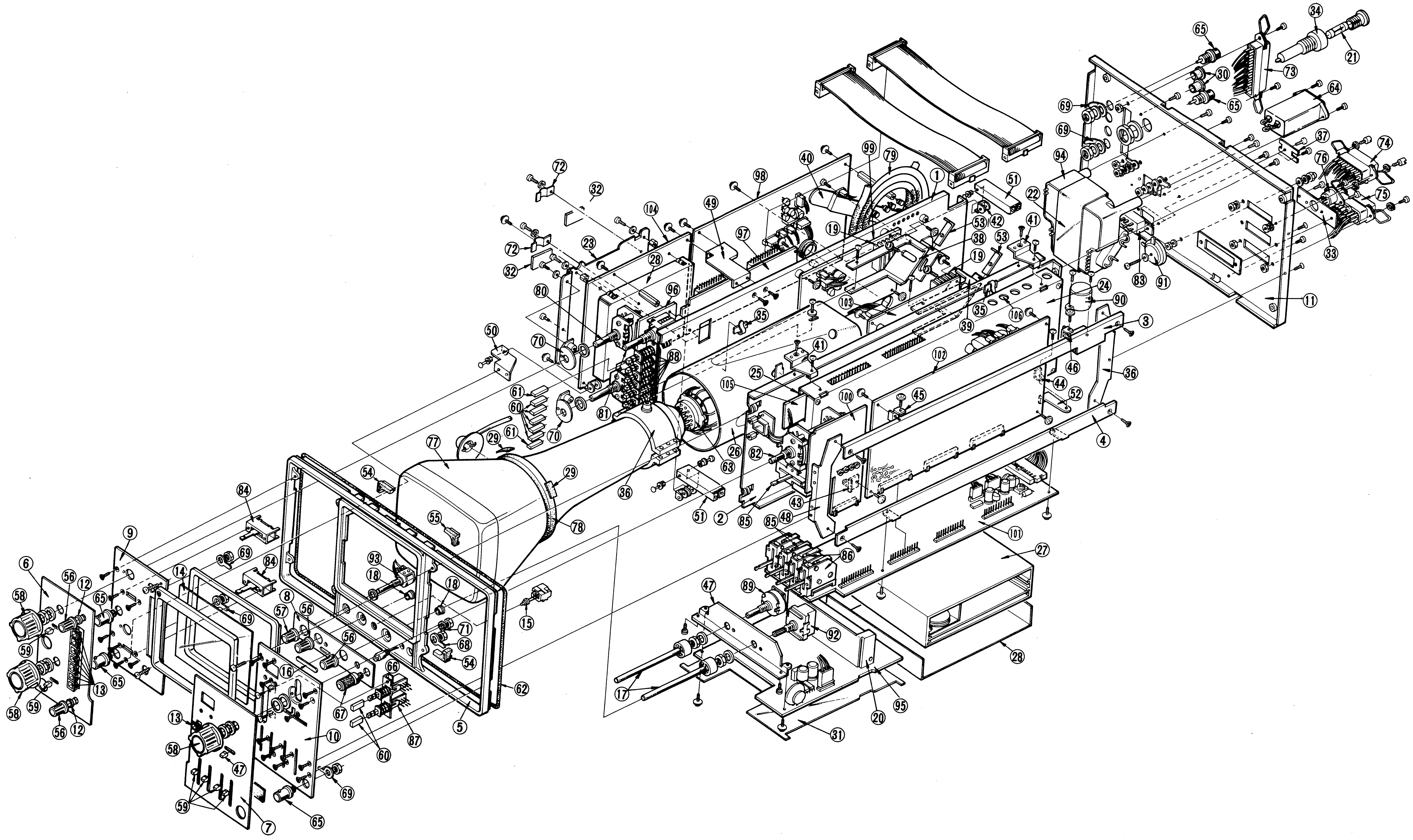
## CS-1720 MAIN CHASSIS

| Fig. & Index No. | Parts No. | Description |
|---|---|---|
| 1-1 | A13-0749-12 | Frame (L) |
| 1-2 | A13-0750-12 | Frame (R) |
| 1-3 | A13-0751-12 | Frame |
| 1-4 | A13-0752-12 | Frame |
| 1-5 | A20-2756-15 | Die casting panel |
| 1-6 | A21-1002-04 | Decorative panel |
| 1-7 | A21-1003-04 | Decorative panel |
| 1-8 | A21-1004-04 | Decorative panel |
| 1-9 | A22-0821-03 | Sub panel (L) |
| 1-10 | A22-0822-13 | Sub panel (R) |
| 1-11 | A23-1634-12 | Rear panel |
| 1-12 | B07-0701-04 | Push escutcheon |
| 1-13 | B07-0706-04 | Push escutcheon |
| 1-14 | B19-0717-03 | Filter |
| 1-15 | B30-0930-15 | LED |
| 1-16 | B40-2765-04 | Name plate (serial No.) |
| 1-17 | D21-0903-04 | Extension shaft |
| 1-18 | D23-0801-04 | Bearing |
| 1-19 | F01-0827-04 | Heat sink |
| 1-20 | F02-0503-04 | Heat sink |
| 1-21 | F05-1224-05 | Fuse (1.2A) |
| 1-22 | F10-1557-04 | Earth band |
| 1-23 | F10-1556-14 | Shield plate |
| 1-24 | F11-0971-02 | Shield case (cover) |
| 1-25 | F11-0972-02 | Shield case |
| 1-26 | F11-0973-02 | Shield cover for CRT |
| 1-27 | W02-0405-15 | Switching power supply |
| 1-28 | F11-0963-03 | Shield case |
| 1-29 | F15-0714-04 | Felt |
| 1-30 | F19-0709-05 | Rubber cap |
| 1-31 | F20-0636-04 | Insulation sheet |
| 1-32 | F20-0613-04 | Insulation sheet |
| 1-33 | F19-0710-04 | Mounting plate for DIN connector |
| 1-34 | J13-0033-15 | Fuse holder |
| 1-35 | J19-1620-05 | Cord keeper |
| 1-36 | J19-1623-04 | CRT band |
| 1-37 | J19-1624-04 | Stopper plate |
| 1-38 | J21-2925-03 | Bracket for CRT |
| 1-39 | J21-2926-03 | Bracket for CRT |
| 1-40 | J21-2871-14 | Bracket for DL |
| 1-41 | J21-2947-04 | Bracket for shield case |
| 1-42 | J29-2905-04 | Bracket |
| 1-43 | J21-2948-04 | Bracket |
| 1-44 | J21-2949-04 | Bracket |
| 1-45 | J21-2950-04 | Bracket |
| 1-46 | J21-2951-04 | Bracket |
| 1-47 | J21-2930-04 | Bracket for VR |
| 1-48 | J21-2942-14 | Bracket |
| 1-49 | J21-2945-04 | Bracket for p.c.b. |
| 1-50 | J21-2943-14 | Bracket for p.c.b. |
| 1-51 | J21-2944-04 | Bracket for p.c.b. |
| 1-52 | J21-2946-04 | Bracket for shield case |
| 1-53 | J29-0505-04 | Retainer clamp |
| 1-54 | J42-0517-04 | Mounting rubber for CRT |
| 1-55 | J42-0518-04 | Mounting rubber for CRT |
| 1-56 | K21-0832-14 | Knob |
| 1-57 | K21-0833-14 | Knob |
| 1-58 | K21-0845-03 | Knob |
| 1-59 | K27-0526-04 | Lever knob |
| 1-60 | K27-0504-04 | Push knob |
| 1-61 | K27-0505-04 | Push knob |
| 1-62 | 002-0006-05 | Shield gasket |
| 1-63 | E01-1403-05 | CRT socket |
| 1-64 | E03-0201-05 | Power connector |
| 1-65 | E04-0251-05 | BNC receptacle |
| 1-66 | E21-0654-04 | CAL terminal |
| 1-67 | E21-0657-04 | Metal terminal |
| 1-68 | E23-0015-04 | Earth lug |
| 1-69 | E23-0513-05 | Earth lug |
| 1-70 | E23-0518-04 | Earth plate |
| 1-71 | E23-0520-05 | Earth lug |
| 1-72 | E23-0522-14 | Earth plate |
| 1-73 | E08-5081-05 | Receptacle |
| 1-74 | E08-2483-05 | Receptacle |
| 1-75 | E08-2482-05 | Receptacle |
| 1-76 | E06-0751-05 | DIN socket |
| 1-77 |  | CRT 140CGB31 |
| 1-78 | L39-0516-05 | Rotator coil |
| 1-79 | L76-0105-05 | Delay line |
| 1-80 | S01-1514-05 | Rotary switch |
| 1-81 | S01-2507-05 | Rotary switch |
| 1-82 | S01-2508-05 | Rotary switch |
| 1-83 | S31-2004-05 | Slide switch |
| 1-84 | S31-2506-05 | Slide switch |
| 1-85 | S33-2501-05 | Lever switch |
| 1-86 | S37-2005-05 | Lever switch |
| 1-87 | S42-2509-05 | Push switch |
| 1-88 | S42-7502-05 | Push switch |
| 1-89 | S59-2503-05 | Power switch |
| 1-90 | T99-0501-05 | Buzzer |
| 1-91 |  | Power thermistor 4W-25 |
| 1-92 | R05-8001-05 | Variable res. 3MΩB |
| 1-93 | R19-9503-05 | Variable res. 1kΩB/10kΩB |
| 1-94 | W02-0406-05 | High voltage power block |
| 1-95 | X68-1350-00 | Power blanking unit |
|  | J25-2948-12 | Printed circuit board |
| 1-96 | X73-1400-00 | Vertical switch unit |
|  | J25-2944-03 | Printed circuit board |
| 1-97 | X73-1410-00 | Vertical logic unit |
|  | J25-2945-12 | Printed circuit board |
| 1-98 | X73-1420-00 | Vertical amplifier unit |
|  | J25-2942-12 | Printed circuit board |
| 1-99 | X73-1430-00 | Vertical output amp unit |
|  | J25-2949-03 | Printed circuit board |
| 1-100 | X74-1260-00 | Horizontal switch unit |
|  | J25-2946-03 | Printed circuit board |
| 1-101 | X74-1270-00 | Horizontal logic unit |
|  | J25-2945-12 | Printed circuit board |
| 1-102 | X74-1280-00 | Sweep unit |
|  | J25-2950-12 | Printed circuit board |
| 1-103 | X74-1290-00 | Horizontal output amp unit |
|  | J25-2949-03 | Printed circuit board |
| 1-104 | X75-1130-00 | Attenuator unit |
|  | J25-2939-12 | Printed circuit board |
| 1-105 | X81-1060-00 | I/O unit |
|  | J25-2933-12 | Printed circuit board |
| 1-106 | X81-1050-00 | CPU unit |
|  | J25-2931-12 | Printed circuit board |

# PARTS LIST

| Ref. No. | Parts No. | Description |
|---|---|---|
| | A01-0889-02 | Case |
| | B07-0710-02 | Rear escutcheon |
| | B42-1835-04 | Voltage indication sheet (90～132V) |
| | B42-1836-04 | Voltage indication sheet (180～264V) |
| | B50-2964-00 | Instruction manual |
| | F20-0627-04 | Insulation sheet for lithium battery |
| | J02-0507-05 | Leg (bottom) |
| | J02-0512-05 | Leg (side) |
| | J32-0824-04 | Hex post (54mm) |
| | J32-0825-04 | Hex post (32mm) |
| | J32-0827-04 | Hex post (7.5mm) |
| | J32-0828-04 | Hex post (13.9mm) |
| | J42-0038-04 | Rubber cap X5 |
| | J61-0049-05 | Cable band |
| | J59-0402-05 | Nylon rivet |
| | K01-0058-25 | Handle |
| | H01-2954-04 | Carton box |
| | H10-2812-12 | Pad (formed styrene) |
| | H20-1713-14 | Pad (carton) |
| | E29-0504-05 | Teflon terminal |
| | E30-1818-05 | JIS cord |
| | E30-1819-05 | CEE cord |
| | E30-1821-05 | SAA cord |
| J1 | E31-2235-05 | Lead wire/connector 5P |
| J2 | E31-2236-05 | Lead wire/connector 5P |
| J3 | E31-2237-05 | Lead wire/connector 8P |
| J4 | E31-2238-05 | Lead wire/connector 7P |
| J5 | E31-2239-05 | Lead wire/connector 5P |
| J6 | E31-2240-05 | Lead wire/connector 5P |
| J7 | E31-2241-05 | Lead wire/connector 6P |
| J8 | E31-2242-05 | Lead wire/connector 8P |
| J9 | E31-2243-05 | Lead wire/connector 6P |
| J10 | E31-2260-05 | Lead wire/connector 4P |
| J11 | E31-2244-05 | Lead wire/connector 2P |
| J12 | E31-2245-05 | Lead wire/connector 2P |
| J13 | E31-2246-05 | Lead wire/connector 5P |
| J14 | E31-2247-05 | Lead wire/connector 3P |
| J15 | E31-2248-05 | Lead wire/connector 7P |
| J16 | E31-2249-05 | Lead wire/connector 5P |
| J17 | E31-2250-05 | Lead wire/connector 3P |
| J18 | E31-2251-05 | Lead wire/connector 3P |
| J19 | E31-2252-05 | Lead wire/connector 3P |
| J20 | E31-2253-05 | Lead wire/connector 2P |
| J21 | E31-2254-05 | Lead wire/connector 3P |
| J22 | E31-2255-05 | Lead wire/connector 3P |
| J23 | E31-2256-05 | Lead wire/connector 4P |
| J24 | No use | |
| J25 | E31-2257-05 | Lead wire/connector 34P |
| J26 | E31-2257-05 | Lead wire/connector 34P |
| J27 | E31-2258-05 | Lead wire/connector 6P |
| J28 | E31-2259-05 | Lead wire/connector 7P |
| J29 | No use | |
| J30 | E31-2261-05 | Lead wire/connector 1P |
| J31 | E31-2275-05 | Lead wire/connector 1P |
| J32 | | |
| J33 | E31-2262-05 | Lead wire/connector 2P |
| J34 | E31-2263-05 | Lead wire/connector 3P |
| J35 | No use | |
| J36 | No use | |
| J37 | E31-2265-05 | Lead wire/connector 3P |
| J38 | No use | |
| J39 | No use | |
| J40 | No use | |
| J41 | No use | |
| J42 | E31-2266-05 | Lead wire/connector 7P |
| J43 | E31-2267-05 | Lead wire/connector 8P |
| J44 | No use | |
| J45 | No use | |
| J46 | E31-2269-05 | Lead wire/connector 1P |
| J47 | E31-2269-05 | Lead wire/connector 1P |
| J48 | E31-2270-05 | Lead wire/connector 2P |
| J49 | E31-2271-05 | Lead wire/connector 2P |
| J50 | No use | |
| J51 | No use | |
| J52 | E31-2274-05 | Lead wire/connector 3P |
| J53 | E31-2261-05 | Lead wire/connector 1P |
| J54 | E31-2275-05 | Lead wire/connector 1P |
| J55 | E31-2276-05 | Lead wire/connector 3P |
| J56 | E31-2277-05 | Lead wire/connector 2P |
| J57 | No use | |
| J58 | No use | |
| J59 | E31-2278-05 | Lead wire/connector 2P |
| J60 | E31-2279-05 | Lead wire/connector 3P |
| J61 | No use | |
| J62 | E31-2280-05 | Lead wire/connector 2P |
| J63 | E31-2281-05 | Lead wire/connector 5P |
| J64 | E31-2282-05 | Lead wire/connector 3P |
| | E31-0564-05 | Lead wire/connector 1P |
| P65 | E31-2283-05 | Lead wire/receptacle |
| P66 | E31-2284-05 | Lead wire/receptacle |
| P67 | E31-2285-05 | Lead wire/receptacle |
| P68 | E31-2268-05 | Lead wire/receptacle |
| R1 | RN14BK2E1200F | Metal film res. 120Ω ±1% 1/4W |
| R2 | RN14BK2H1503F | Metal film res. 150kΩ ±1% 1/2W |
| R3 | RN14BK2H1503F | Metal film res. 150kΩ ±1% 1/2W |
| C1 | CK45E3D472P | Ceramic cap. 4700pF +100%<br>−0% 2000V |
| C2 | CK45E3D472P | Ceramic cap. 4700pF +100%<br>−0% 2000V |
| C3 | C91-0551-05 | Metal film cap. 0.22μF 600V |
| | W02-0405-15 | Switching power supply |
| | W09-0403-05 | Lithium battery 3V |
| | Y87-1250-00 | Probe PC-29 |

# DISASSEMBLY/PARTS LIST (1)



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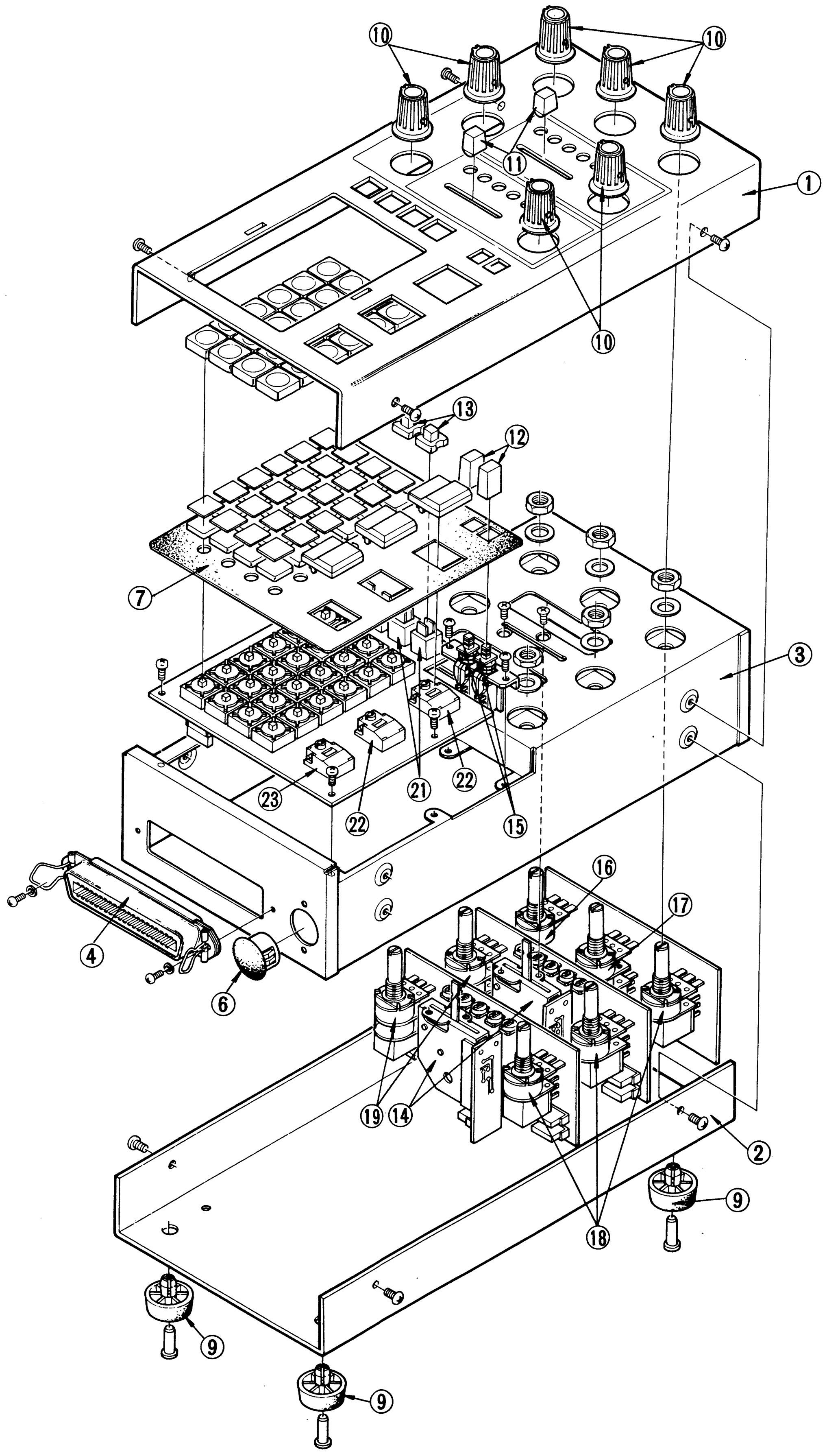
# DISASSEMBLY/PARTS LIST (2)



# PARTS LIST

**REMOTE CONTROLLER (RT-1721)**

| Fig. & Index No. | Parts No. | Description |
|---|---|---|
| 2-1 | A01-0878-03 | Case (top) |
| 2-2 | A01-0879-03 | Case (bottom) |
| 2-3 | A10-1431-02 | Chassis |
| 2-4 | E08-5081-05 | Receptacle 50P |
| 2-5 | F07-0920-04 | Button cover |
| 2-6 | F19-0708-05 | Bushing |
| 2-7 | F15-0718-04 | Blind sheet |
| 2-8 | F20-0635-04 | Insulation sheet |
| 2-9 | J02-0507-05 | Leg |
| 2-10 | K21-0820-04 | Knob |
| 2-11 | K27-0502-04 | Lever knob |
| 2-12 | K27-0504-04 | Push knob (grey) |
| 2-13 | K27-0524-04 | Push knob |
| 2-14 | S33-2501-05 | Lever switch |
| 2-15 | S42-2510-05 | Push switch |
| 2-16 | R01-2503-05 | Variable res. 10kΩB |
| 2-17 | R01-4505-05 | Variable res. 50kΩB |
| 2-18 | R01-2504-05 | Variable res. 5kΩB |
| 2-19 | R01-2513-05 | Variable res. 5kΩB |
| 2-20 | S40-1507-05 | Tact switch |
| 2-21 | S40-1504-05 | Tact switch |
| 2-22 | S40-1508-05 | Digitast switch |
| 2-23 | S40-1509-05 | Digitast switch |
|  | B40-2737-04 | Name plate (serial No.) |
|  | B41-0737-04 | Caution sheet |
|  | E30-1842-05 | Cable CB-5020S |
|  | E31-2231-15 | Lead wire/receptacle |
|  | E31-2232-05 | Lead wire/connector |
|  | B42-1840-04 | Key board indication sheet (7) |
|  | B42-1841-04 | Key board indication sheet (4) |
|  | B42-1842-04 | Key board indication sheet (1) |
|  | B42-1843-04 | Key board indication sheet (0) |
|  | B42-1844-04 | Key board indication sheet (8) |
|  | B42-1845-04 | Key board indication sheet (5) |
|  | B42-1846-04 | Key board indication sheet (2) |
|  | B42-1847-04 | Key board indication sheet (STRT) |
|  | B42-1848-04 | Key board indication sheet (9) |
|  | B42-1849-04 | Key board indication sheet (6) |
|  | B42-1850-04 | Key board indication sheet (3) |
|  | B42-1851-04 | Key board indication sheet (END) |
|  | B42-1852-04 | Key board indication sheet (STO) |
|  | B42-1853-04 | Key board indication sheet (PART WRT) |
|  | B42-1854-04 | Key board indication sheet (ALL WRT) |
|  | B42-1855-04 | Key board indication sheet (READ) |
|  | B42-1856-04 | Key board indication sheet (SCAN) |
|  | B42-1857-04 | Key board indication sheet (PRNT) |
|  | B42-1858-04 | Key board indication sheet (SAVE) |
|  | B42-1859-04 | Key board indication sheet (LOAD) |
|  | B42-1860-04 | Key board indication sheet (FREE) |
|  | B42-1861-04 | Key board indication sheet (EXT) |
|  | B42-1864-04 | Key board indication sheet |
|  | X77-1180-00 | Remote unit |
|  | X81-1120-00 | Key board unit |
|  | H01-2938-04 | Carton box |
|  | H12-0538-04 | Pad |
|  | H25-0820-04 | Polyethylene bag |
|  | H10-2814-02 | Pad (foamed styrene) |

**REMOTE UNIT (X77-1180-00)**

| Fig. & Index No. | Ref. No. | Parts No. | Description | |
|---|---|---|---|---|
| A-2 | R1 | RD14BB2C272J | RD | 2.7kΩ |
| A-2 | R2 | RD14BB2C272J | RD | 2.7kΩ |
| A-2 | R3 | RD14BB2C272J | RD | 2.7kΩ |
| A-2 | R4 | RD14BB2C272J | RD | 2.7kΩ |
| A-2 | R5 | RD14BB2C272J | RD | 2.7kΩ |
| A-2 | R6 | RD14BB2C272J | RD | 2.7kΩ |
| A-2 | R7 | RD14BB2C272J | RD | 2.7kΩ |
| A-3 | R8 | RD14BB2C272J | RD | 2.7kΩ |
| A-3 | R9 | RD14BB2C272J | RD | 2.7kΩ |
| A-3 | R10 | RD14BB2C272J | RD | 2.7kΩ |
| B-2 | R11 | RD14BB2C102J | RD | 1kΩ |
| B-2 | R12 | RD14BB2C102J | RD | 1kΩ |
| B-2 | R13 | RD14BB2C102J | RD | 1kΩ |
| B-2 | R14 | RD14BB2C102J | RD | 1kΩ |
| B-2 | R15 | RD14BB2C102J | RD | 1kΩ |
| B-2 | R16 | RD14BB2C102J | RD | 1kΩ |
| B-3 | R17 | RD14BB2C102J | RD | 1kΩ |
| B-3 | R18 | RD14BB2C102J | RD | 1kΩ |
| B-3 | R19 | RD14BB2C102J | RD | 1kΩ |
| B-3 | R20 | RD14BB2C102J | RD | 1kΩ |
| B-3 | R21 | RD14BB2C332J | RD | 3.3kΩ |
| B-3 | R22 | RD14BB2C332J | RD | 3.3kΩ |
| B-3 | R23 | RD14BB2C182J | RD | 1.8kΩ |
| B-3 | R24 | RD14BB2C182J | RD | 1.8kΩ |
| B-3 | R25 | RD14BB2C392J | RD | 3.9kΩ |
| B-3 | R26 | RD14BB2C392J | RD | 3.9kΩ |
| A-4 | R27 | RD14BB2C103J | RD | 10kΩ |
| A-4 | R28 | RD14BB2C103J | RD | 10kΩ |
| A-3 | R29 | RD14BB2C103J | RD | 10kΩ |
| A-1 | R30 | RD14BB2C103J | RD | 10kΩ |
| B-2 | R31 | RD14BB2C222J | RD | 2.2kΩ |
|  | R32 | No use | | |
|  | R33 | No use | | |
|  | R34 | No use | | |
|  | R35 | No use | | |
|  | R36 | No use | | |
|  | R37 | No use | | |
|  | R38 | No use | | |
|  | R39 | No use | | |
|  | R40 | No use | | |
| C-2 | R41 | RD14BB2C272J | RD | 2.7kΩ |
| C-2 | R42 | RD14BB2C272J | RD | 2.7kΩ |
| C-2 | R43 | RD14BB2C272J | RD | 2.7kΩ |
| C-2 | R44 | RD14BB2C272J | RD | 2.7kΩ |
| C-2 | R45 | RD14BB2C272J | RD | 2.7kΩ |
| C-2 | R46 | RD14BB2C272J | RD | 2.7kΩ |
| C-2 | R47 | RD14BB2C272J | RD | 2.7kΩ |
| B-3 | R48 | RD14BB2C272J | RD | 2.7kΩ |
| B-3 | R49 | RD14BB2C272J | RD | 2.7kΩ |
| B-3 | R50 | RD14BB2C272J | RD | 2.7kΩ |
| C-2 | R51 | RD14BB2C102J | RD | 1kΩ |
| C-2 | R52 | RD14BB2C102J | RD | 1kΩ |
| C-2 | R53 | RD14BB2C102J | RD | 1kΩ |
| C-2 | R54 | RD14BB2C102J | RD | 1kΩ |
| C-2 | R55 | RD14BB2C102J | RD | 1kΩ |
| C-2 | R56 | RD14BB2C102J | RD | 1kΩ |
| C-3 | R57 | RD14BB2C102J | RD | 1kΩ |
| C-3 | R58 | RD14BB2C102J | RD | 1kΩ |
| C-3 | R59 | RD14BB2C102J | RD | 1kΩ |
| C-3 | R60 | RD14BB2C102J | RD | 1kΩ |
| C-3 | R61 | RD14BB2C332J | RD | 3.3kΩ |
| C-3 | R62 | RD14BB2C332J | RD | 3.3kΩ |
| C-3 | R63 | RD14BB2C182J | RD | 1.8kΩ |
| C-3 | R64 | RD14BB2C182J | RD | 1.8kΩ |
| C-3 | R65 | RD14BB2C392J | RD | 3.9kΩ |
| C-3 | R66 | RD14BB2C392J | RD | 3.9kΩ |
| C-4 | R67 | RD14BB2C103J | RD | 10kΩ |
| C-4 | R68 | RD14BB2C103J | RD | 10kΩ |
| C-3 | R69 | RD14BB2C103J | RD | 10kΩ |
| C-1 | R70 | RD14BB2C103J | RD | 10kΩ |
| C-2 | R71 | RD14BB2C222J | RD | 2.2kΩ |
|  | R72 | No use | | |
|  | R73 | No use | | |
|  | R74 | No use | | |
|  | R75 | No use | | |
|  | R76 | No use | | |
|  | R77 | No use | | |
|  | R78 | No use | | |
|  | R79 | No use | | |
|  | R80 | No use | | |

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| B-2 |

# PARTS LIST

## KEY BOARD UNIT (X81-1120-00)

| Fig. & Index No. | Ref. No. | Parts No. | Description |
|---|---|---|---|
| A-3 | R1 | RD14BB2C333J | RD 33kΩ |
| B-3 | R2 | RD14BB2C333J | RD 33kΩ |
| B-3 | R3 | RD14BB2C333J | RD 33kΩ |
| B-3 | R4 | RD14BB2C333J | RD 33kΩ |
| C-3 | R5 | RD14BB2C333J | RD 33kΩ |
| C-3 | R6 | RD14BB2C333J | RD 33kΩ |
| C-3 | R7 | RD14BB2C333J | RD 33kΩ |
| C-3 | R8 | RD14BB2C333J | RD 33kΩ |
| C-1 | R9 | RD14BB2C391J | RD 390Ω |
| C-2 | R10 | RD14BB2C391J | RD 390Ω |
| C-2 | R11 | RD14BB2C391J | RD 390Ω |
| C-2 | R12 | RD14BB2C391J | RD 390Ω |
| C-1 | C1 | CK45B1H222K | CK 2200pF ±10% |
| C-1 | C2 | CK45B1H222K | CK 2200pF ±10% |
| C-2 | C3 | CK45B1H222K | CK 2200pF ±10% |
| C-2 | C4 | CK45B1H222K | CK 2200pF ±10% |
| A-3 | C5 | C90-0298-05 | Semiconductor ceramic<br>0.1μF 12V |
| A-2 | D1 |  | Diode 1N60 |
| A-3 | D2 |  | Diode 1N60 |
| A-2 | D3 |  | Diode 1N60 |
| A-2 | D4 |  | Diode 1N60 |
| B-3 | IC1 |  | IC SN74LS148N |
| A-1 | S1 | S40-1507-05 | Tact switch |
| A-2 | S2 | S40-1507-05 | Tact switch |
| A-2 | S3 | S40-1507-05 | Tact switch |
| A-2 | S4 | S40-1507-05 | Tact switch |
| A-1 | S5 | S40-1507-05 | Tact switch |
| A-2 | S6 | S40-1507-05 | Tact switch |
| A-2 | S7 | S40-1507-05 | Tact switch |
| A-2 | S8 | S40-1507-05 | Tact switch |
| B-1 | S9 | S40-1507-05 | Tact switch |
| B-2 | S10 | S40-1507-05 | Tact switch |
| B-2 | S11 | S40-1507-05 | Tact switch |
| B-2 | S12 | S40-1507-05 | Tact switch |
| B-1 | S13 | S40-1507-05 | Tact switch |
| B-2 | S14 | S40-1507-05 | Tact switch |
| B-2 | S15 | S40-1507-05 | Tact switch |
| B-2 | S16 | S40-1507-05 | Tact switch |
| B-1 | S17 | S40-1507-05 | Tact switch |
| B-2 | S18 | S40-1507-05 | Tact switch |
| B-2 | S19 | S40-1507-05 | Tact switch |
| B-2 | S20 | S40-1507-05 | Tact switch |
| C-1 | S21 | S40-1507-05 | Tact switch |
| C-2 | S22 | S40-1507-05 | Tact switch |
| C-2 | S23 | S40-1507-05 | Tact switch |
| C-2 | S24 | S40-1507-05 | Tact switch |
| C-1 | S25 | S40-1504-05 | Tact switch |
| C-2 | S26 | S40-1504-05 | Tact switch |
| C-2 | S27 | S40-1504-05 | Tact switch |
| C-2 | S28 | S40-1504-05 | Tact switch |
| A-3 | S29 | S40-1509-05 | Digital switch |
| B-3 | S30 | S40-1508-05 | Digital switch |
| C-3 | S31 | S40-1508-05 | Digital switch |
| A-3 | P8 | E40-0676-05 | Pin connector 6P |
| C-3 | P9 | E40-0576-05 | Pin connector 5P |
| C-3 | P10 | E40-0476-05 | Pin connector 4P |
| B-3 | P11 | E40-0376-05 | Pin connector 3P |
|  |  | J25-2941-02 | Printed circuit board |

## MEMORY PACK (MT-1725)

| Ref. No. | Parts No. | Description |
|---|---|---|
|  | A01-0875-04 | Case |
|  | A50-0502-04 | Side panel |
|  | A50-0503-04 | Side panel |
|  | B42-1839-04 | Name plate (serial No.) |
|  | G13-0707-04 | Cushion |
|  | H01-2935-03 | Carton box |
|  | H03-1858-04 | Carton box |
|  | H21-0802-04 | Protective sheet |
|  | H25-0016-00 | Polyethylene bag |
|  | W09-0403-05 | Lithium battery |
|  | X81-1070-00 | Memory unit |

## MEMORY UNIT (X81-1070-00)

| Fig. & Index No. | Ref. No. | Parts No. | Description |
|---|---|---|---|
| R1 | A-2 | RD14BB2C472J | RD 4.7kΩ |
| R2 | A-2 | RD14BB2C561J | RD 560Ω |
| R3 | A-2 | RD14BB2C272J | RD 2.7kΩ |
| R4 | B-2 | RD14BB2C224J | RD 220kΩ |
| R5 | B-2 | RD14BB2C331J | RD 330Ω |
| R6 | B-2 | RD14BB2C474J | RD 470kΩ |
| R7 | B-1 | RD14BB2C103J | RD 10kΩ |
| R8 | B-2 | RD14BB2C472J | RD 4.7kΩ |
| R9 | B-2 | RD14BB2C472J | RD 4.7kΩ |
| R10 | B-2 | RD14BB2C222J | RD 2.2kΩ |
| R11 | B-2 | RN14BK2B6801F | RN 6.8kΩ ±1% 1/8W |
| VR1 | B-2 | R-12-1511-05 | VR 2kΩB |
| C1 | A-2 | C91-0549-05 | Tantalum 1μF 35V |
| C2 | B-2 | CK45B1H103K | CK 0.01μF ±10% |
| C3 | B-1 | CK45B1H103K | CK 0.01μF ±10% |
| C4 | B-1 | CC45CH1H680J | CC 68pF ±5% |
| Q1 | A-2 |  | TR 2SC945 (Q) |
| D1 | A-2 |  | Diode 1S1544A |
| D2 | B-2 |  | Diode 1S1544A |
| D3 | B-2 |  | Diode WZ-032 |
| IC1 | A-1 |  | IC M5L8216P |
| IC2 | A-1 |  | IC MB8414EM |
| IC3 | B-1 |  | IC TC4040BP |
| IC4 | B-1 |  | IC TC4001BP |
| IC5 |  | B-2 | IC TL061CP |
| P1 |  | E09-2482-05 | Plug |
|  |  | J25-2930-04 | Printed circuit board |

# PARTS LIST

| Ref. No. | Parts No. | Description |
|---|---|---|
| 1 | RN14BK2B1202F | RN 12kΩ ±1% 1/8W |
| 2 | RD14BB2C472J | RD 4.7kΩ |
| 3 | RD14BB2C472J | RD 4.7kΩ |
| 4 | RD14BB2C123J | RD 12kΩ |
| 1 | R12-2509-05 | VR 5kΩB |
| 2 | R12-2509-05 | VR 5kΩB |
| 3 | R12-2509-05 | VR 5kΩB |
| 4 | R12-2509-05 | VR 5kΩB |
| 5 | R12-2509-05 | VR 5kΩB |
| 6 | R01-2504-05 | VR 5kΩB (S1) |
| 7 | R01-2513-05 | VR 5kΩB (S2) |
| 8 | R12-2509-05 | VR 5kΩB |
| 9 | R12-2509-05 | VR 5kΩB |
| 10 | R12-2509-05 | VR 5kΩB |
| 11 | R12-2509-05 | VR 5kΩB |
| 12 | R12-2509-05 | VR 5kΩB |
| 13 | R01-2504-05 | VR 5kΩB (S4) |
| 14 | R01-2513-05 | VR 5kΩB (S5) |
| 15 | R01-4505-05 | VR 50kΩB (S7) |
| 16 | R01-4505-05 | VR 5kΩB (S7) |
| 17 | R01-2504-05 | VR 5kΩB (S8) |
|  | CK45B1H103K | CK 0.01μF ±10% |
|  | CK45B1H103K | CK 0.01μF ±10% |
|  | CK45B1H103K | CK 0.01μF ±10% |
|  |  | TR 2SA608KNP (F) |
|  |  | TR 2SA608KNP (F) |
|  |  | TR 2SA608KNP (F) |
|  |  | TR 2SA608KNP (F) |
|  |  | TR 2SA608KNP (F) |
|  |  | TR 2SA608KNP (F) |
|  |  | TR 2SA608KNP (F) |
|  |  | TR 2SA608KNP (F) |
|  |  | TR 2SA608KNP (F) |
|  |  | TR 2SA608KNP (F) |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  | No use |  |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | Diode DS442X |
|  |  | IC SN74LS42N |
|  |  | IC SN74LS42N |
|  | S33-2501-05 | Lever switch |
|  | S33-2501-05 | Lever switch |
|  | S42-2510-05 | Push switch |
|  | S42-2510-05 | Push switch |
|  | E40-0876-05 | Pin connector 8P |
|  | E40-0676-05 | Pin connector 6P |
|  | E40-0476-05 | Pin connector 4P |
|  | E40-0876-05 | Pin connector 8P |

| Fig. & Index No. | Ref. No. | Parts No. | Description |
|---|---|---|---|
| B-3 | P5 | E40-0676-05 | Pin connector 6P |
| B-3 | P6 | E40-0476-05 | Pin connector 4P |
| D-2 | P7 | E40-0976-05 | Pin connector 9P |
| D-1 | P12 | E40-0376-05 | Pin connector 3P |
|  |  | J25-2940-02 | Printed circuit board |

# VOLTAGES AND WAVEFORMS

The voltages and waveforms are measured on each schematic diagram as follows;

## TEST EQUIPMENT

| | |
|---|---|
| Digital multimeter | : DL-720 (TRIO) |
| Oscilloscope | : CS-2100 (TRIO) |
| Sine wave generator | : SG-502 (TEKTRONIX) |

**Voltage Measurements**

Voltage measurements are taken with no signal applied and the trace positioned to the center horizontal graticule line. The digital multimeter common should be connected to chassis ground at the nearest measurement point.

**Waveform Condition**

Waveforms are measured with 1 kHz 10 mVp-p sine wave applied CH1 input.

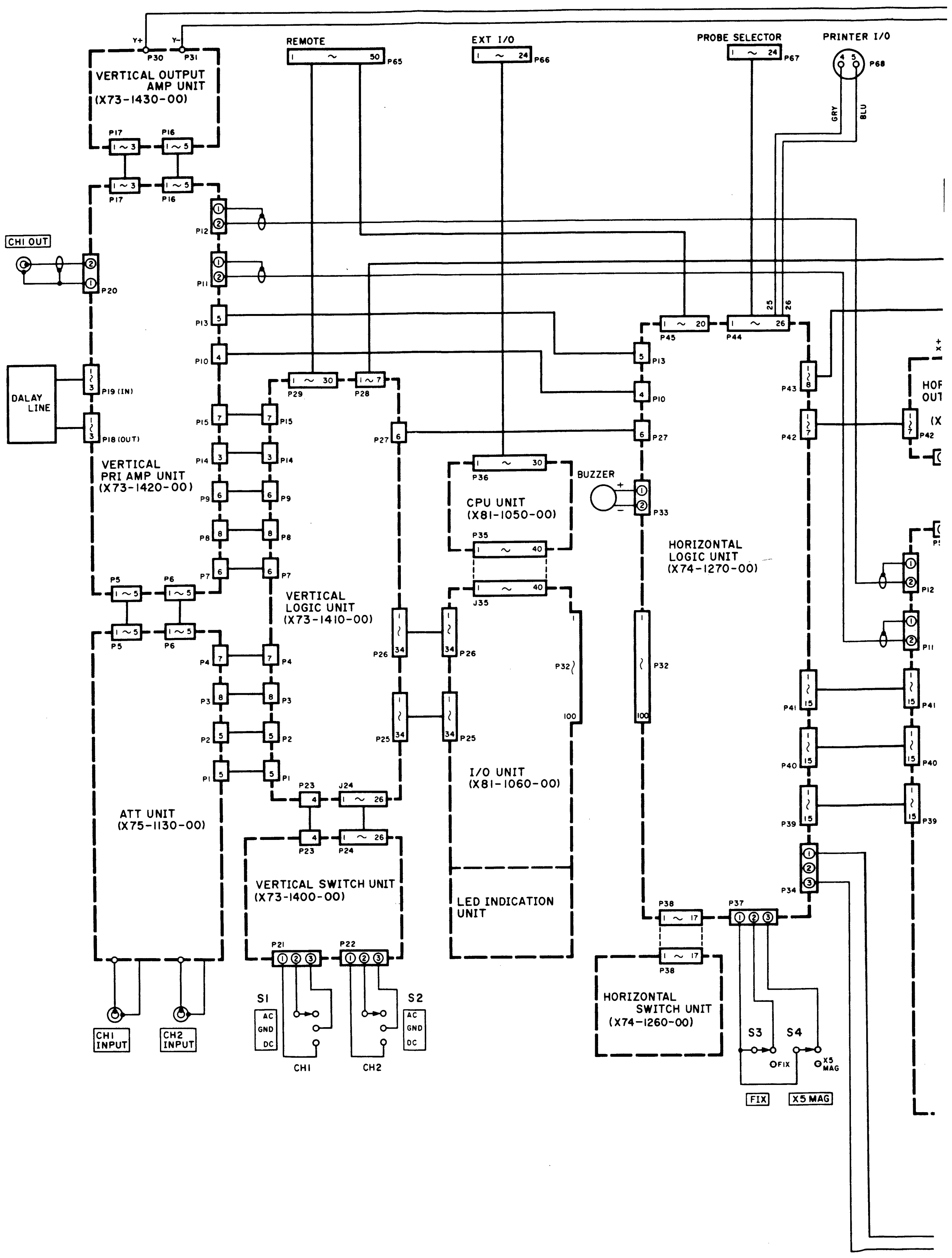
## CONTROL SETTINGS

| | |
|---|---|
| INTENSITY | Midrange |
| FOCUS | Midrange |
| ▲▼ POSITION | Midrange |
| VOLTS/DIV | 2 mV |
| V. VARI | CAL |
| CW2 INV | OFF (■) |
| V. MODE | Unless otherwise specified CH1 and SEP OFF (■) |
| COUPLING | AC |
| SLOPE | CH1 +/+ |
| TRIG MODE | AUTO |
| SWEEP TIME/DIV | 1 ms |
| SWEEP TIME VARI | CAL |
| ◄► POSITION | Midrange |
| X5MAG | OFF (■) |

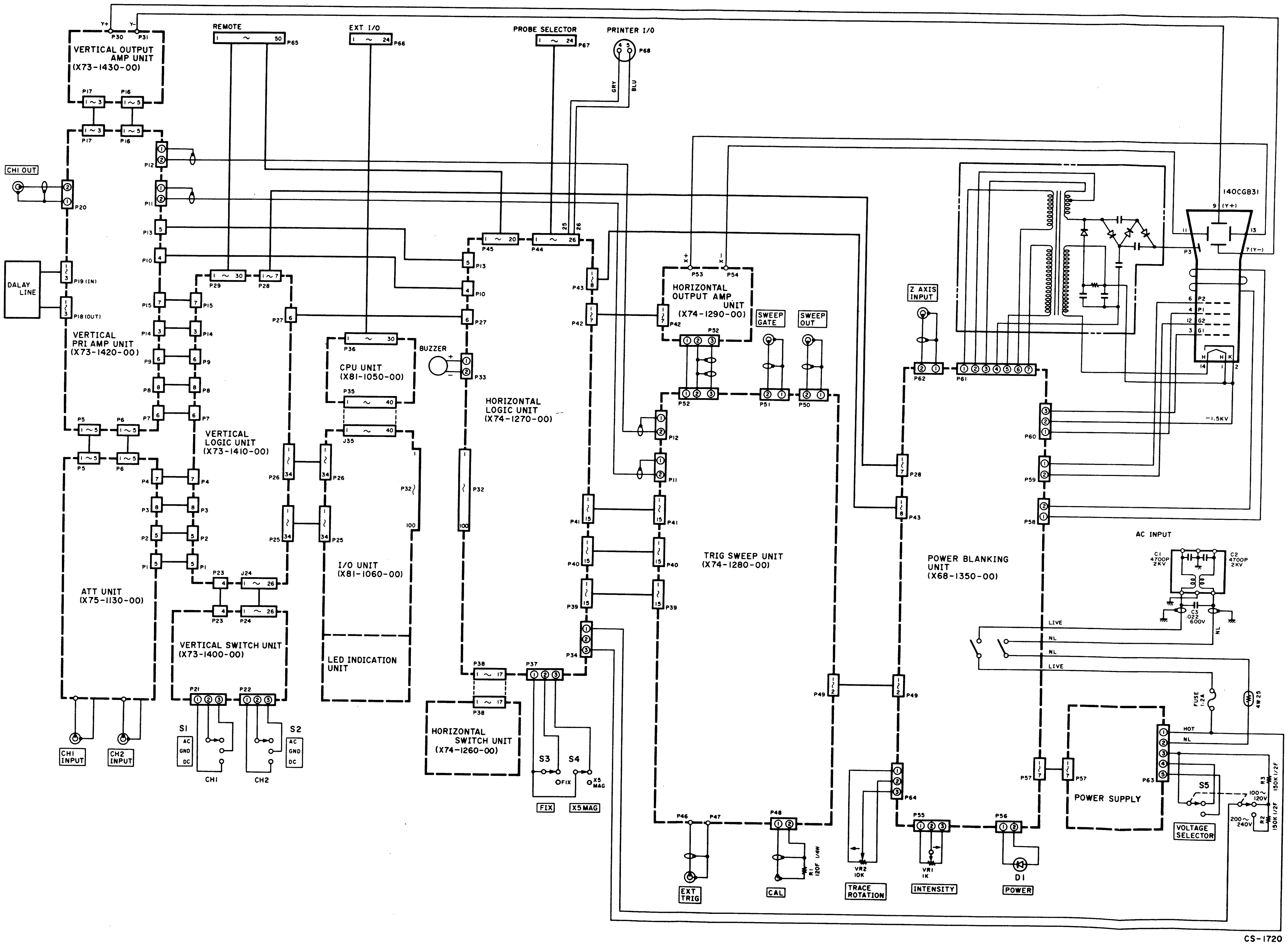
## NOTE:

In differencial circuit, the voltages and waveforms are shown only CH1

# SCHEMATIC DIA

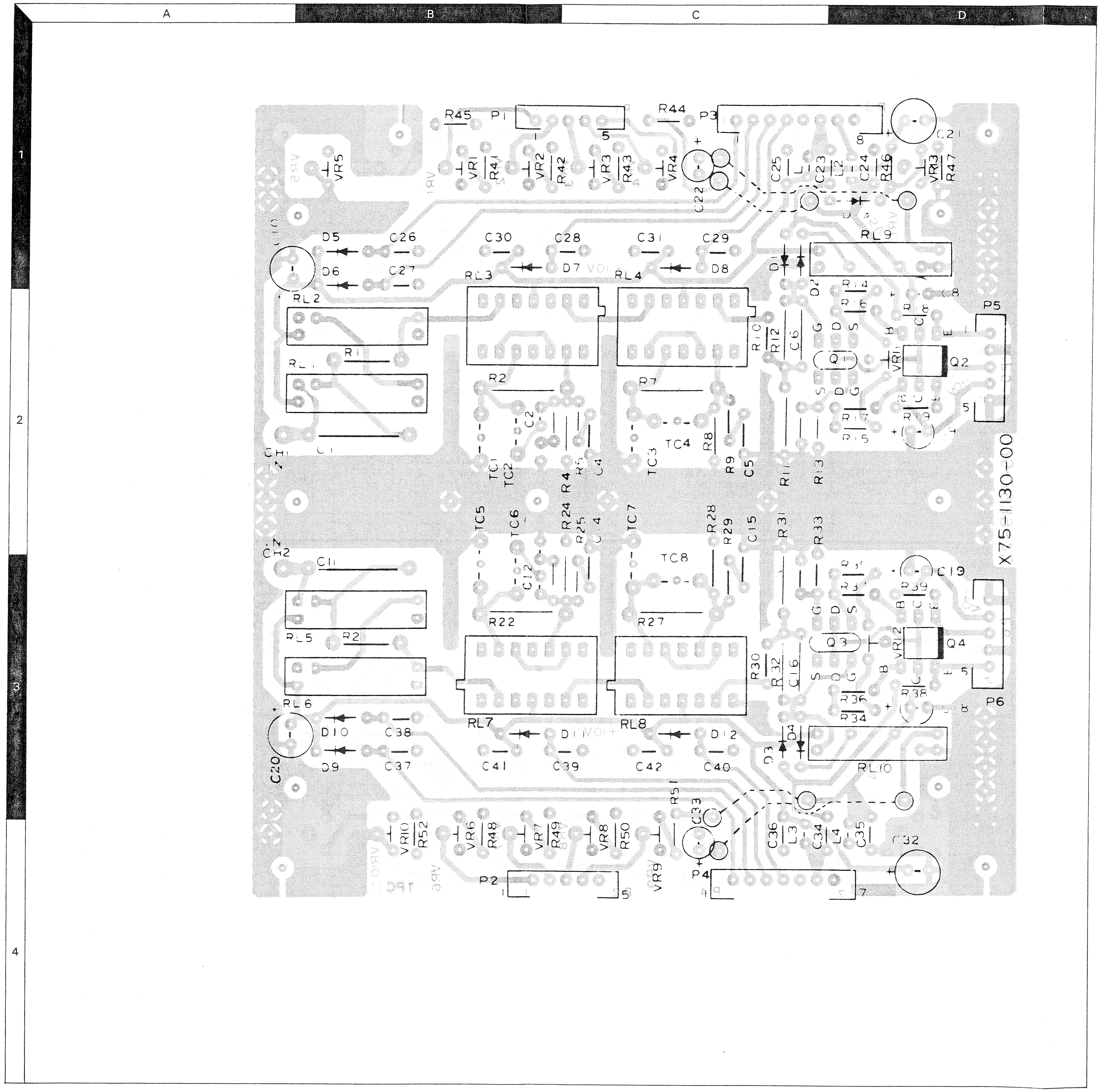

VERTICAL OUTPUT AMP UNIT (X73-1430-00)
Y+
Y-
P30
P31
P17
P16
REMOTE
P65
EXT I/O
P66
PROBE SELECTOR
P67
PRINTER I/O
P68
GRY
BLU
CH1 OUT
P20
P12
P11
P13
P10
DALAY LINE
P19 (IN)
P18 (OUT)
VERTICAL PRI AMP UNIT (X73-1420-00)
P15
P14
P9
P8
P7
P5
P6
P29
P28
P27
VERTICAL LOGIC UNIT (X73-1410-00)
P26
P25
P4
P3
P2
P1
P23
J24
P24
ATT UNIT (X75-1130-00)
VERTICAL SWITCH UNIT (X73-1400-00)
P21
P22
S1
S2
AC
GND
DC
CH1
CH2
CH1 INPUT
CH2 INPUT
CPU UNIT (X81-1050-00)
P36
P35
J35
BUZZER
P33
I/O UNIT (X81-1060-00)
P32
LED INDICATION UNIT
P45
P44
HORIZONTAL LOGIC UNIT (X74-1270-00)
P43
P42
P41
P40
P39
P34
P38
P37
HORIZONTAL SWITCH UNIT (X74-1260-00)
S3
S4
FIX
X5 MAG
HOR OUT

# SCHEMATIC DIAGRAM

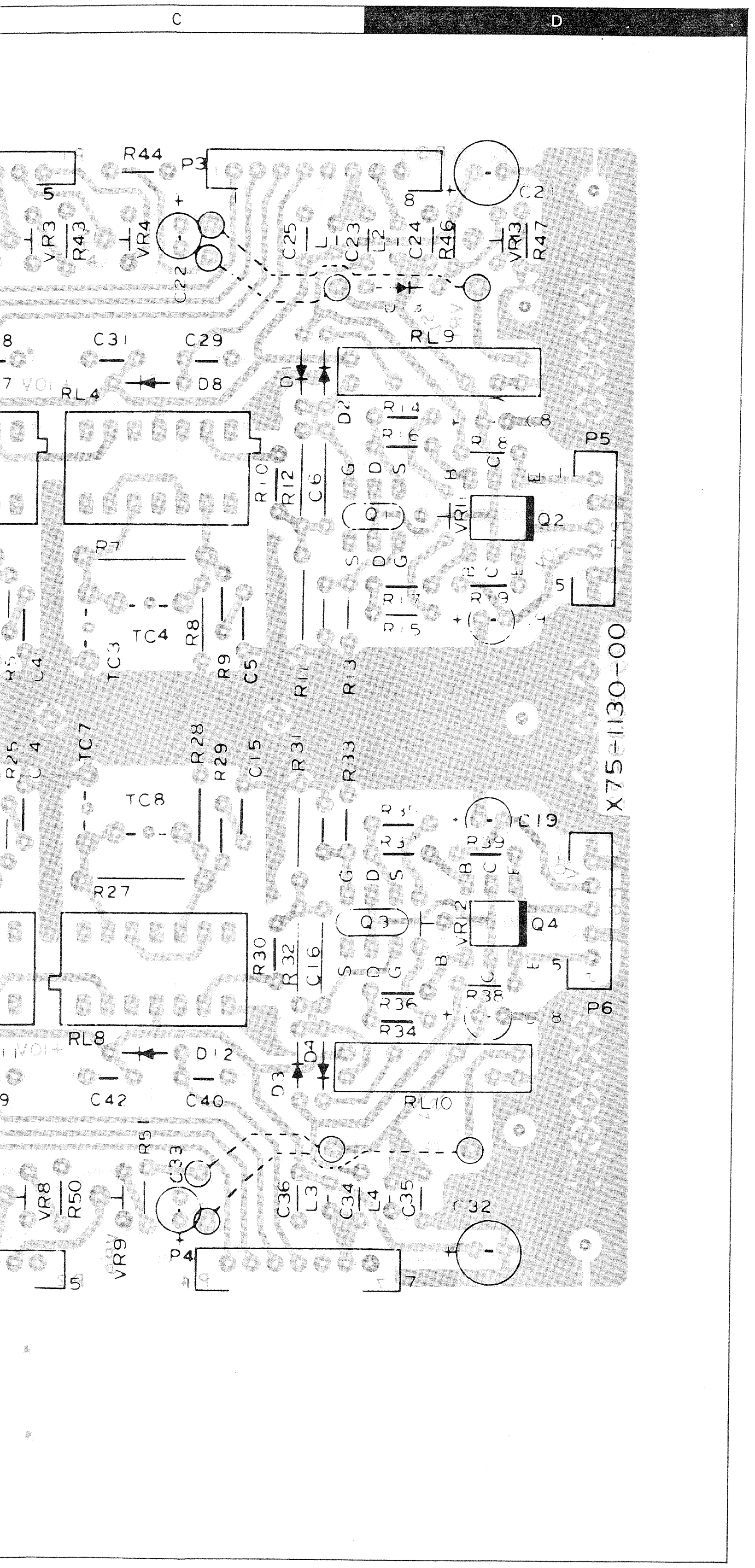

VERTICAL OUTPUT AMP UNIT (X73-1430-00)
REMOTE
EXT I/O
PROBE SELECTOR
PRINTER I/O
GRY
BLU
CH1 OUT
DALAY LINE
P19 (IN)
P18 (OUT)
VERTICAL PRI AMP UNIT (X73-1420-00)
VERTICAL LOGIC UNIT (X73-1410-00)
CPU UNIT (X81-1050-00)
BUZZER
HORIZONTAL LOGIC UNIT (X74-1270-00)
HORIZONTAL OUTPUT AMP UNIT (X74-1290-00)
SWEEP GATE
SWEEP OUT
Z AXIS INPUT
140CGB31
9 (Y+)
7 (Y-)
-1.5KV
I/O UNIT (X81-1060-00)
LED INDICATION UNIT
ATT UNIT (X75-1130-00)
VERTICAL SWITCH UNIT (X73-1400-00)
TRIG SWEEP UNIT (X74-1280-00)
POWER BLANKING UNIT (X68-1350-00)
AC INPUT
C1 4700P 2KV
C2 4700P 2KV
C3 .022 600V
LIVE
NL
FUSE 1.2A
4W 25
HOT
HORIZONTAL SWITCH UNIT (X74-1260-00)
POWER SUPPLY
S5
100~120V
200~240V
R3 150K 1/2F
R2 150K 1/2F
VOLTAGE SELECTOR
CH1 INPUT
CH2 INPUT
S1
S2
AC
GND
DC
CH1
CH2
S3
S4
FIX
X5 MAG
EXT TRIG
CAL
R1 120F 1/4W
VR2 10K
TRACE ROTATION
VR1 1K
INTENSITY
D1
POWER
CS-1720

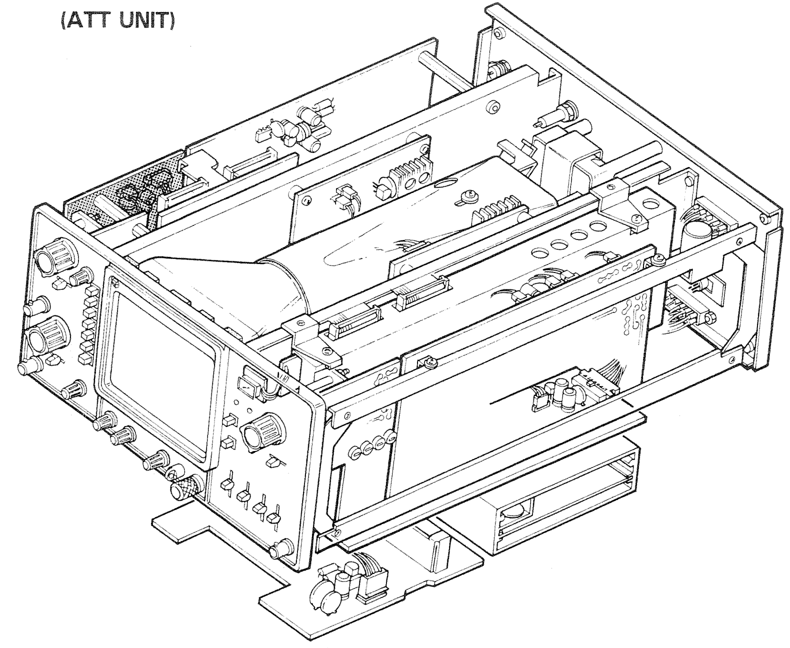
# P.C. BOARD

**X75-1130-00**


A
B
C
D
1
2
3
4
R45
P1
5
R44
P3
8
C21
VR5
VR1
R41
VR2
R42
VR3
R43
VR4
C22
C25
L1
C23
L2
C24
R46
VR13
R47
C10
D5
C26
D6
C27
C30
C28
D7
C31
C29
D8
D1
D2
RL9
RL2
RL3
RL4
R1
RL1
R10
R12
C6
G
D
S
Q1
VR11
Q2
P5
C1
R2
C2
TC1
TC2
R4
R5
C4
R7
TC3
TC4
R8
R9
C5
R11
R13
TC5
TC6
R24
R25
C14
TC7
R28
R29
C15
R31
R33
X75-1130-00
C11
C12
TC8
C19
R39
R22
R27
Q3
VR12
Q4
RL5
R21
R30
R32
C16
R36
R38
R34
P6
RL6
D10
C38
D11
D12
D3
D4
RL7
RL8
RL10
C20
D9
C37
C41
C39
C42
C40
R51
C33
C36
L3
C34
L4
C35
C32
VR10
R52
VR6
R48
VR7
R49
VR8
R50
VR9
P2
P4
7

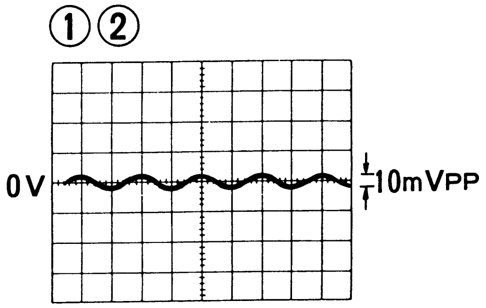
# OARD


C
D
X75-1130-00
P3
P4
P5
P6
R44
VR3
R43
VR4
C22
C25
L2
C23
C24
R46
VR13
R47
C21
C31
C29
D8
RL4
RL9
D1
D2
R10
R12
C6
Q1
VR11
Q2
R7
TC3
TC4
R8
R9
C5
R11
R13
TC7
R25
R28
R29
C15
R31
R33
TC8
C19
R39
R27
Q3
VR12
Q4
R30
R32
C16
R36
R34
R38
RL8
D12
D3
D4
C42
C40
RL10
R51
C33
VR8
R50
VR9
C36
L3
C34
L4
C35
C32



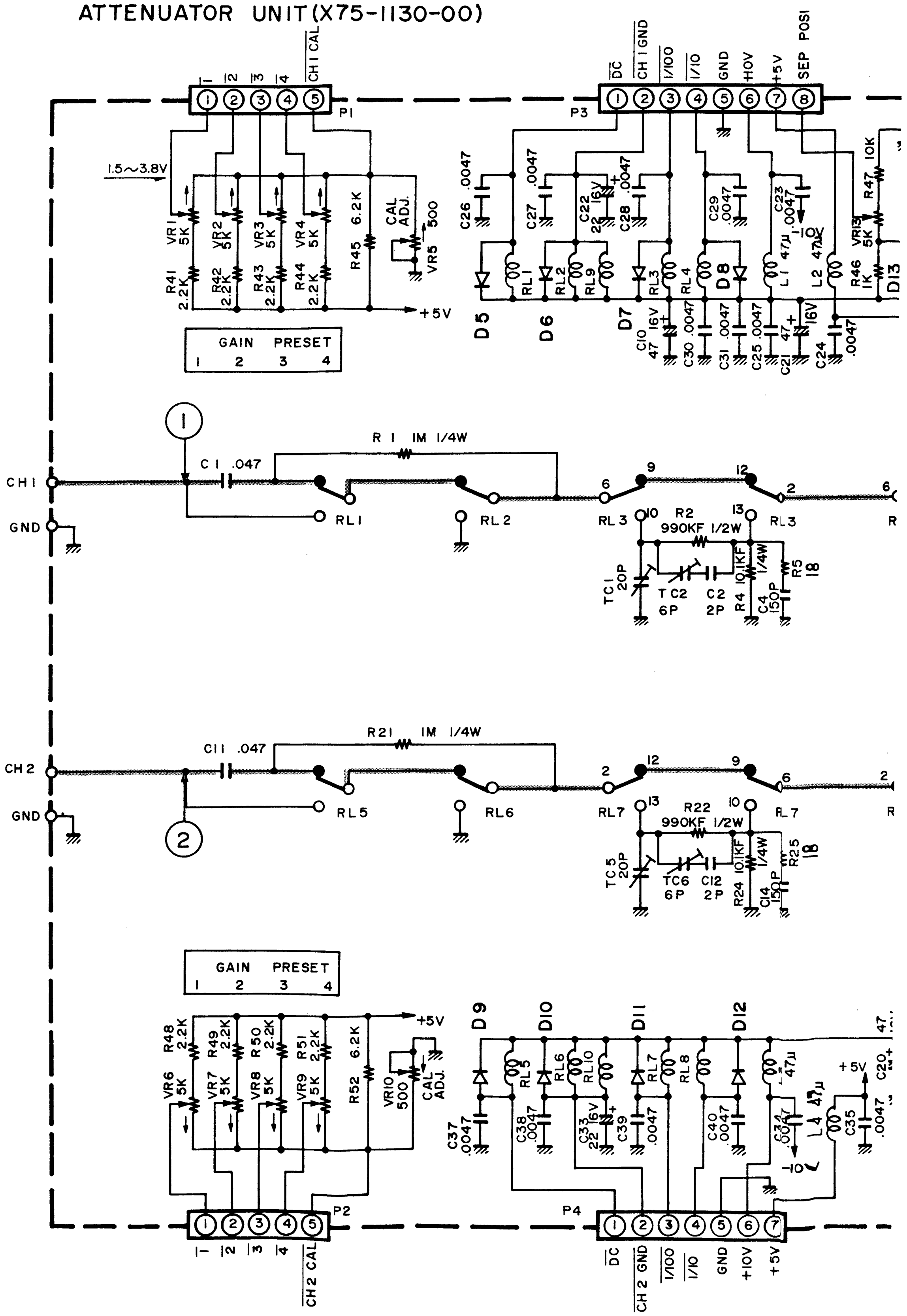
X75-1130-00
(ATT UNIT)

# WAVEFORM



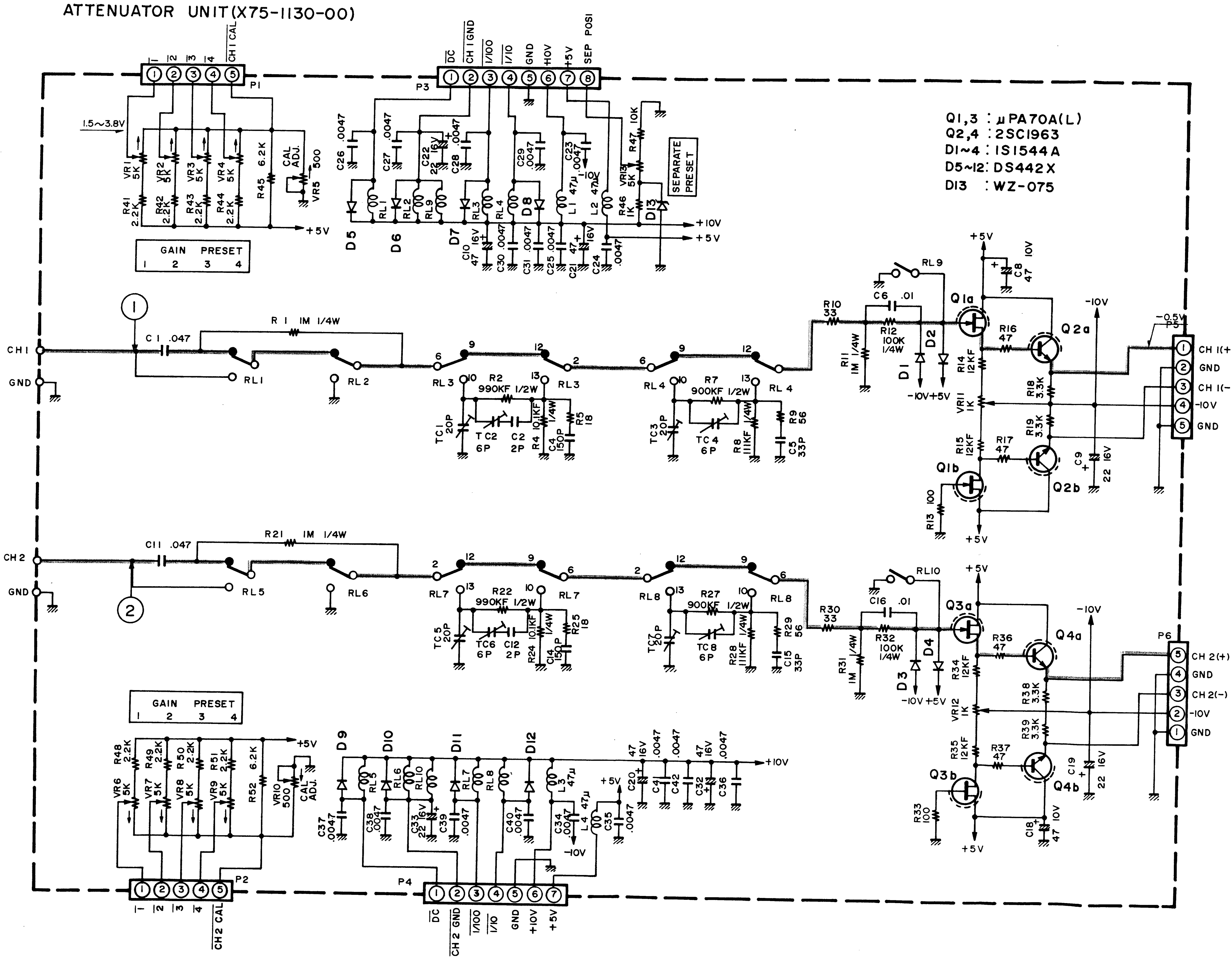
# SCHEMATIC DI

X75-1130-00


ATTENUATOR UNIT(X75-1130-00)
P1
1 2 3 4 CH1 CAL
P3
DC CH1 GND 1/100 1/10 GND +10V +5V SEP POSI
1.5~3.8V
VR1 5K
VR2 5K
VR3 5K
VR4 5K
R41 2.2K
R42 2.2K
R43 2.2K
R44 2.2K
R45 6.2K
CAL ADJ.
VR5 500
+5V
GAIN PRESET
1 2 3 4
D5
D6
D7
D8
D13
RL1
RL2
RL3
RL4
RL9
C26 .0047
C27 .0047
C22 22 16V
C28 .0047
C29 .0047
C23 .0047
L1 47μ
L2 47μ
C10 47 16V
C30 .0047
C31 .0047
C25 .0047
C21 47 16V
C24 .0047
R46 1K
VR13 5K
R47 10K
①
CH1
GND
C1 .047
R1 1M 1/4W
RL1
RL2
RL3
R2 990KF 1/2W
TC1 20P
TC2 6P
C2 2P
R4 10.1KF 1/4W
C4 150P
R5 18
CH2
GND
C11 .047
R21 1M 1/4W
RL5
RL6
RL7
R22 990KF 1/2W
TC5 20P
TC6 6P
C12 2P
R24 10.1KF 1/4W
C14 150P
R25 18
②
GAIN PRESET
1 2 3 4
R48 2.2K
R49 2.2K
R50 2.2K
R51 2.2K
R52 6.2K
VR6 5K
VR7 5K
VR8 5K
VR9 5K
VR10 500
CAL ADJ.
+5V
D9
D10
D11
D12
RL5
RL6
RL7
RL8
RL10
C37 .0047
C38 .0047
C33 22 16V
C39 .0047
C40 .0047
C34 .0047
L4 47μ
C35 .0047
C20 47
+5V
-10
P2
1 2 3 4 CH2 CAL
P4
DC CH2 GND 1/100 1/10 GND +10V +5V

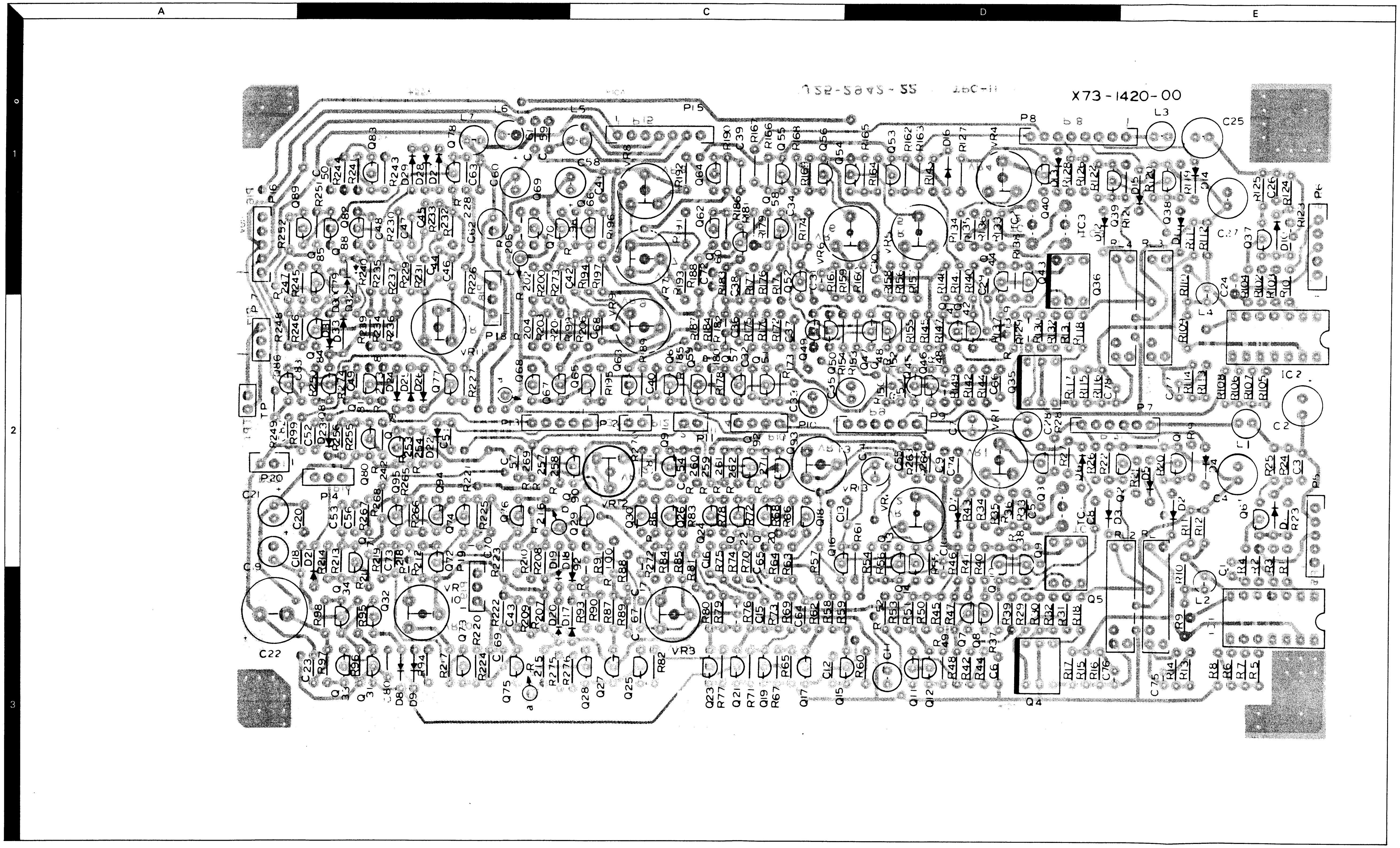
# SCHEMATIC DIAGRAM

**X75-1130-00**

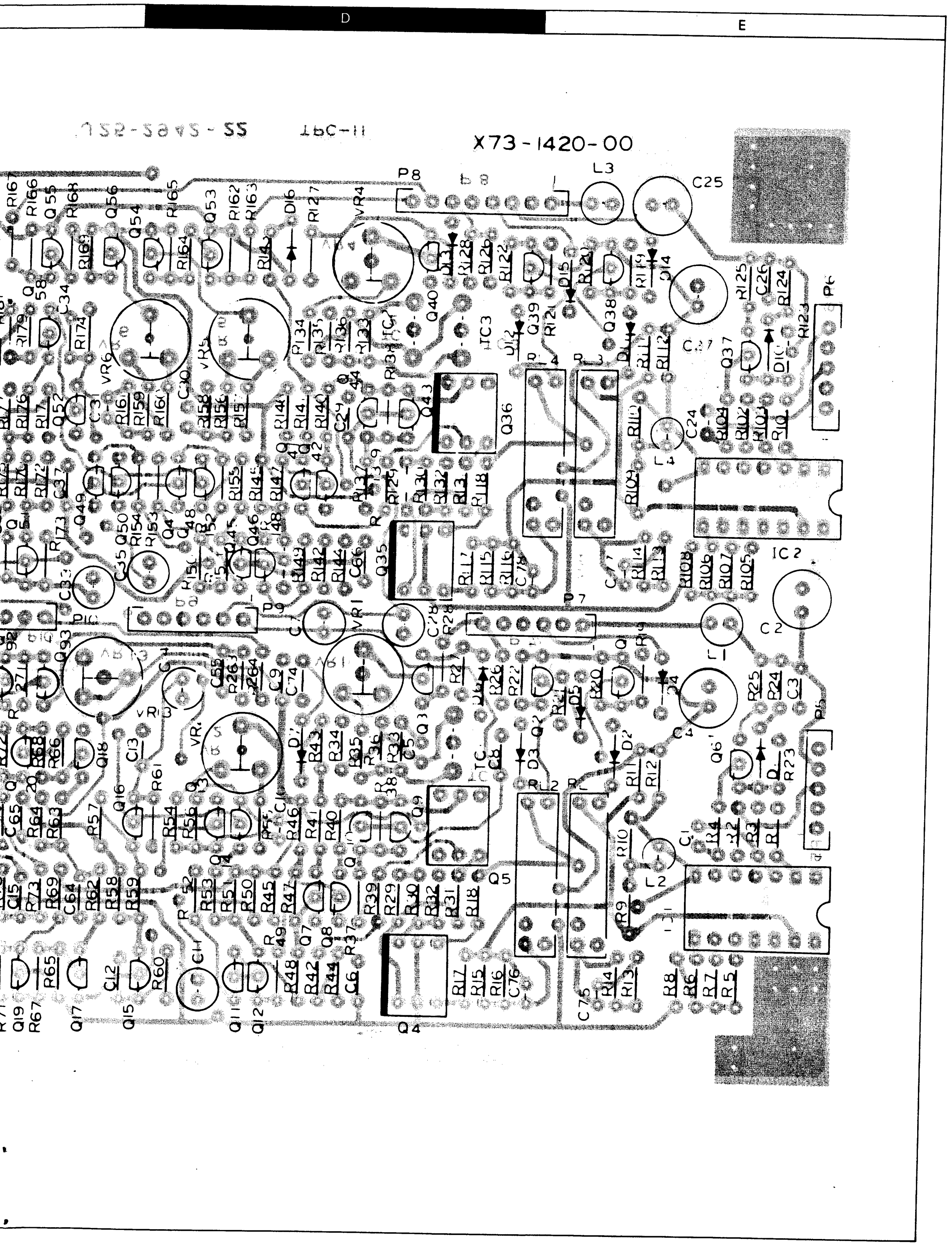

ATTENUATOR UNIT(X75-1130-00)
Q1,3 : μPA70A(L)
Q2,4 : 2SC1963
D1~4 : 1S1544A
D5~12: DS442X
D13 : WZ-075
P1
1 2 3 4 CH1 CAL
1.5~3.8V
VR1 5K
VR2 5K
VR3 5K
VR4 5K
R41 2.2K
R42 2.2K
R43 2.2K
R44 2.2K
R45 6.2K
CAL ADJ.
VR5 500
+5V
GAIN PRESET
1 2 3 4
P3
DC
CH1 GND
1/100
1/10
GND
+10V
+5V
SEP POSI
C26 .0047
C27 .0047
C22 22 16V
C28 .0047
C29 .0047
C23 .0047
VR13 5K
R47 10K
R46 1K
D13
SEPARATE PRESET
RL1
RL2
RL9
RL3
RL4
D8
L1 47μ
L2 47μ
-10V
D5
D6
D7
C10 47 16V
C30 .0047
C31 .0047
C25 .0047
C21 47 16V
C24 .0047
+10V
+5V
CH1
GND
1
C1 .047
R1 1M 1/4W
RL1
RL2
RL3
R2 990KF 1/2W
TC1 20P
TC2 6P
C2 2P
R4 101KF 1/4W
C4 150P
R5 18
RL4
R7 900KF 1/2W
TC3 20P
TC4 6P
R8 111KF 1/4W
C5 33P
R9 56
R10 33
R11 1M 1/4W
C6 .01
R12 100K 1/4W
D1
D2
-10V
+5V
RL9
+5V
C8 47 10V
Q1a
R16 47
Q2a
R14 12KF
R18 3.3K
VR11 1K
R19 3.3K
R15 12KF
R17 47
Q1b
R13 100
C9 22 16V
Q2b
-10V
-0.5V
P5
CH1(+)
GND
CH1(-)
-10V
GND
CH2
GND
2
C11 .047
R21 1M 1/4W
RL5
RL6
RL7
R22 990KF 1/2W
TC5 20P
TC6 6P
C12 2P
R24 101KF 1/4W
C14 150P
R25 18
RL8
R27 900KF 1/2W
TC7 20P
TC8 6P
R28 111KF 1/4W
C15 33P
R29 56
R30 33
R31 1M 1/4W
C16 .01
R32 100K 1/4W
D3
D4
RL10
Q3a
R36 47
Q4a
R34 12KF
R38 3.3K
VR12 1K
R39 3.3K
R35 12KF
R37 47
Q3b
R33 100
C19 22 16V
Q4b
C18 47 10V
P6
CH2(+)
GND
CH2(-)
-10V
GND
GAIN PRESET
1 2 3 4
R48 2.2K
R49 2.2K
R50 2.2K
R51 2.2K
R52 6.2K
VR6 5K
VR7 5K
VR8 5K
VR9 5K
VR10 500
CAL ADJ.
D9
D10
D11
D12
RL5
RL6
RL10
RL7
RL8
L3 47μ
L4 47μ
C37 .0047
C38 .0047
C33 22 16V
C39 .0047
C40 .0047
C34 .0047
C35 .0047
C20 47 16V
C41 .0047
C42 .0047
C32 47 16V
C36 .0047
+10V
P2
1 2 3 4 CH2 CAL
P4
DC
CH2 GND
1/100
1/10
GND
+10V
+5V

# P.C. BOARD

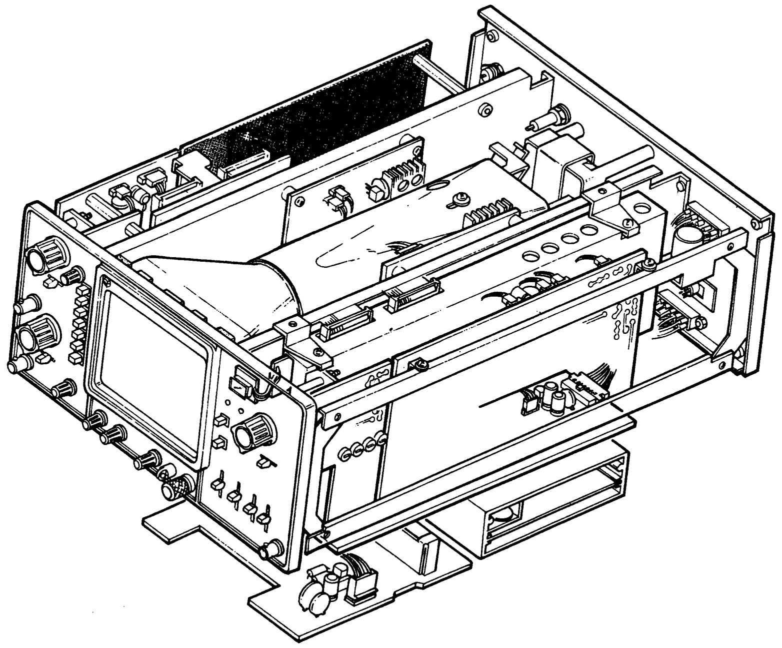
X73-1420-00


A
C
D
E
0
1
2
3
X73-1420-00

# OARD


D
E
X73-1420-00
P8
L3
C25
P7
P9
IC2
C2
L1
L2
Q4
Q5
Q35
Q36
VR1
VR4

X73-1420-00
(VERTICAL AMP. UNIT)

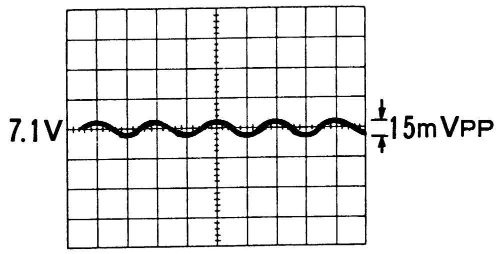


## WAVEFORM

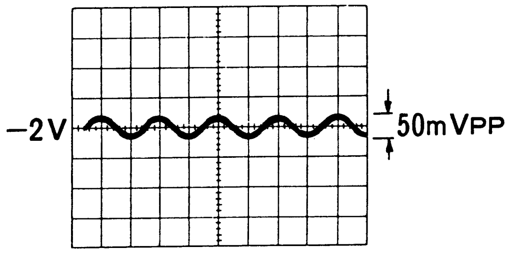
## SCHEMATIC DIAG

X73-1420-00

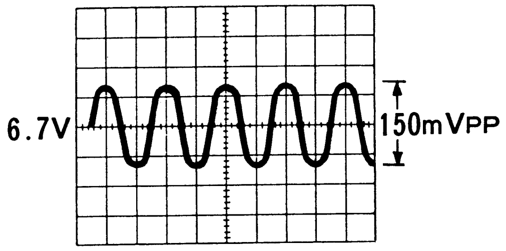
①



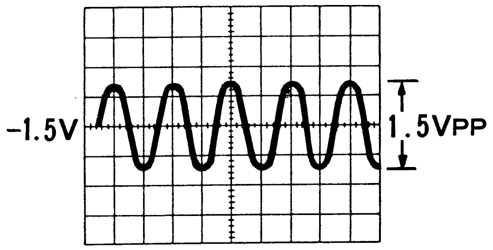
②



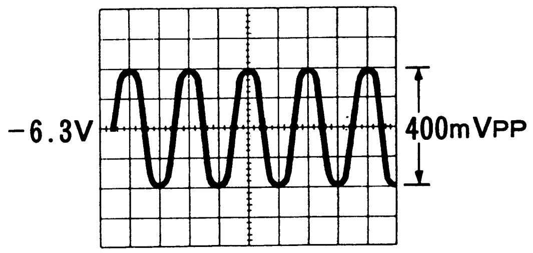
③



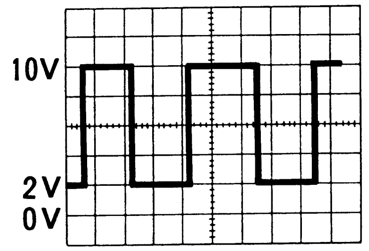
④



⑤

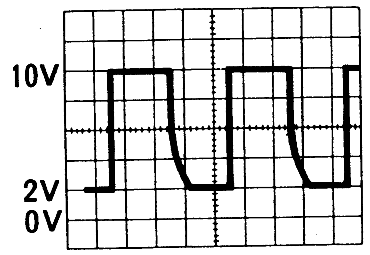


⑥



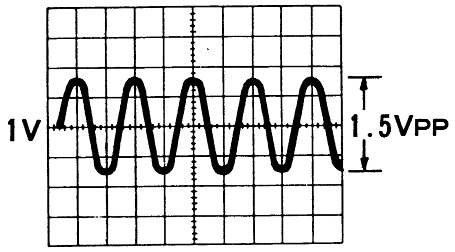
SEP:ON

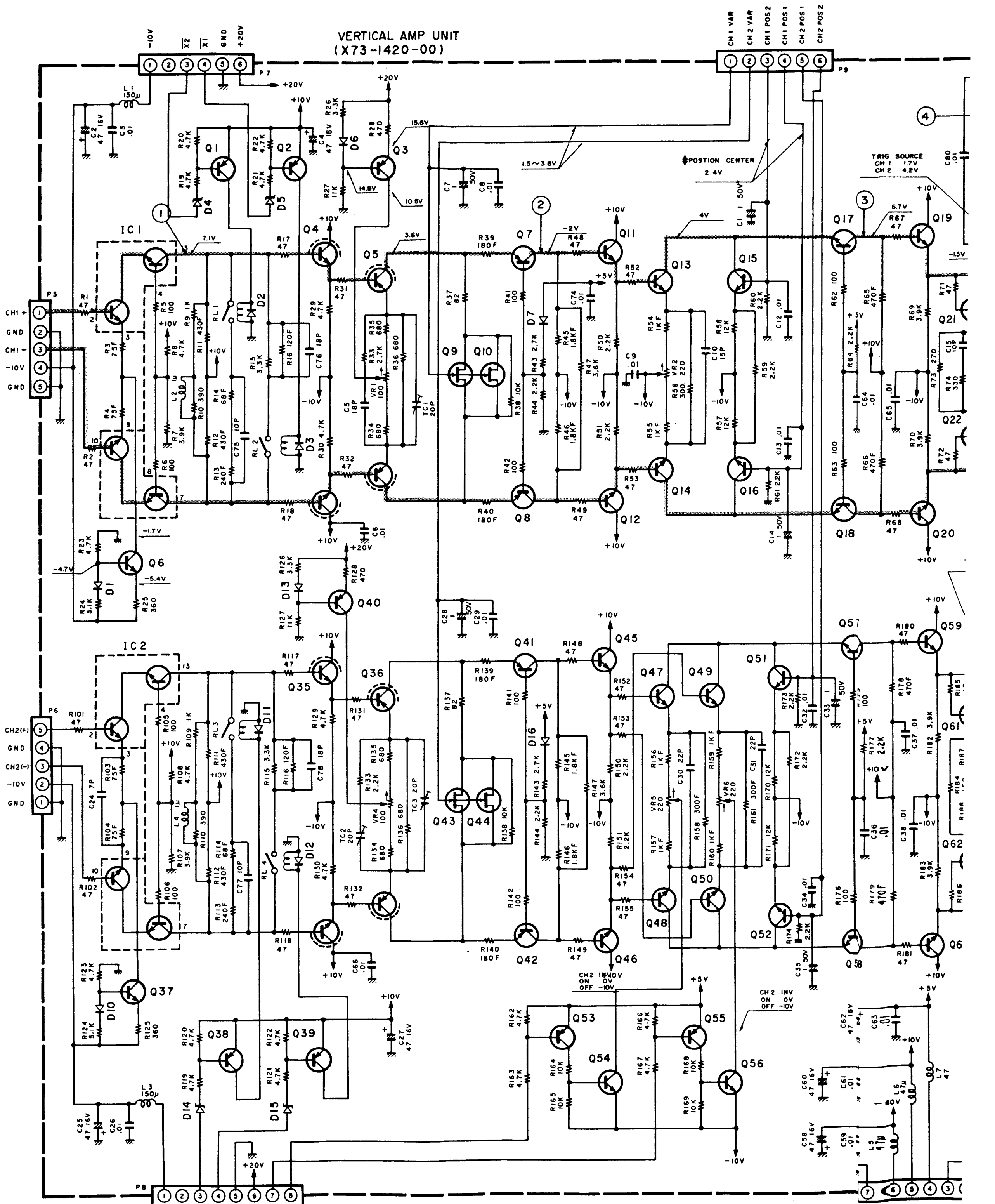
⑦



SEP:ON

⑧




VERTICAL AMP UNIT
(X73-1420-00)
P7
P5
P6
P8
P9
−10V
X2
X1
GND
+20V
CH1 VAR
CH2 VAR
CH1 POS2
CH1 POS1
CH2 POS1
CH2 POS2
CH1+
GND
CH1−
−10V
CH2(+)
CH2(−)
IC1
IC2
INV
TRIG SOURCE
CH1 1.7V
CH2 4.2V
POSTION CENTER
2.4V
1.5～3.8V
CH2 INV
ON 0V
OFF −10V
CH2 INVOV
+5V
+10V

Q1~3,38~42,53,55,71,79
 80,85 :2SA608KNP(F)
Q4,35 :2SC1963
Q5,36 :2SA884
Q6,37,54,56,72,83,84
 :2SC536KNP(F)

Q7,8,21~30,32,61~70,81,82
 86,89 :2SA838(C)
Q9,43 :2SK30A(GR)
Q10,44 :2SK68A(M)
Q11~20,31,45~52,57~60,73
 74,77,78,87,88,90~95
 :2SC1047(C)

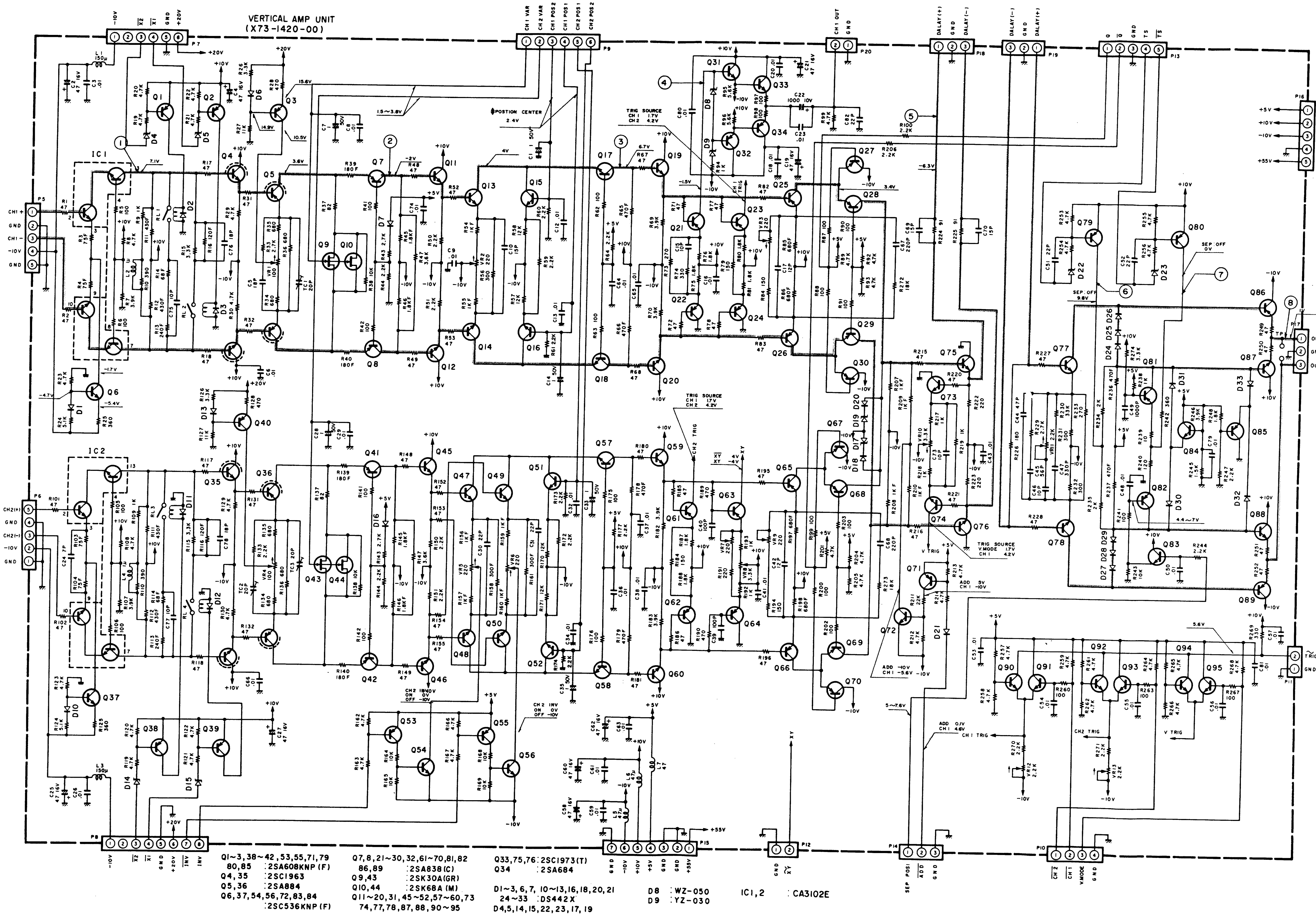
Q33,75,76:2SC1973(T)
Q34 :2SA684

D1~3,6,7, 10~13,16,18,2(21
 24~33 :DS442X
D4,5,14,15,22,23,17,19
 :WZ-071

D8 :
D9 :

# SCHEMATIC DIAGRAM

**X73-1420-00**


VERTICAL AMP UNIT
(X73-1420-00)
P5
P6
P7
P8
P9
P10
P11
P12
P13
P14
P15
P16
P17
P18
P19
P20
IC1
IC2
CH1 VAR
CH2 VAR
CH1 POS2
CH1 POS1
CH2 POS1
CH2 POS2
CH1 OUT
DALAY(+)
DALAY(-)
POSTION CENTER
TRIG SOURCE
SEP OFF
OUT(+)
OUT(-)
TRIG
V TRIG
CH1 TRIG
CH2 TRIG
+55V
+20V
+10V
+5V
-10V
GND

Q1~3,38~42,53,55,71,79
80,85 :2SA608KNP(F)
Q4,35 :2SC1963
Q5,36 :2SA884
Q6,37,54,56,72,83,84
:2SC536KNP(F)

Q7,8,21~30,32,61~70,81,82
86,89 :2SA838(C)
Q9,43 :2SK30A(GR)
Q10,44 :2SK68A(M)
Q11~20,31,45~52,57~60,73
74,77,78,87,88,90~95
:2SC1047(C)

Q33,75,76 :2SC1973(T)
Q34 :2SA684

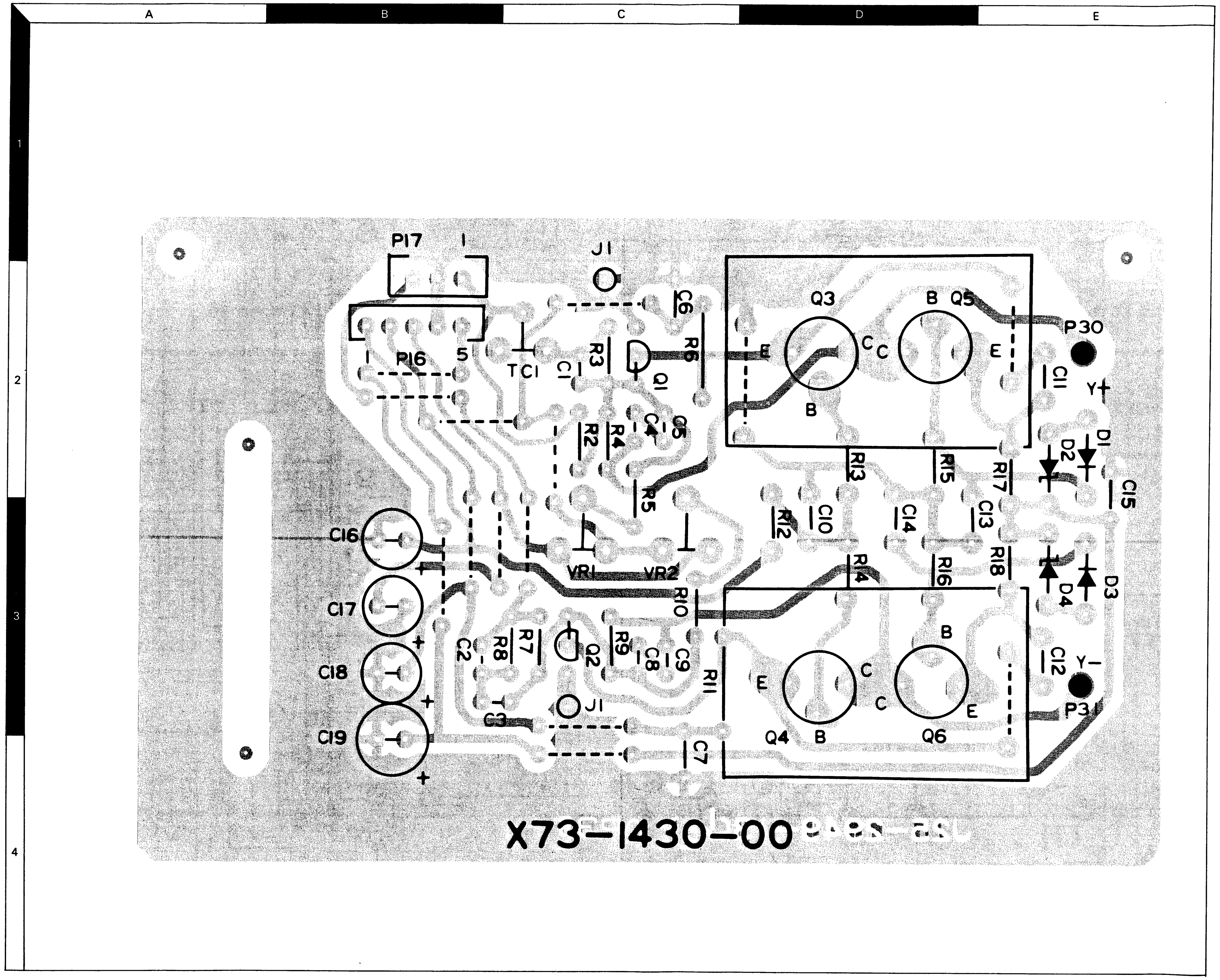
D1~3,6,7, 10~13,16,18,20,21
24~33 :DS442X
D4,5,14,15,22,23,17,19
:WZ-071

D8 :WZ-050
D9 :YZ-030

IC1,2 :CA3102E

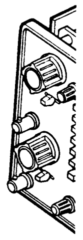
# P.C. BOARD

X73-1430-00

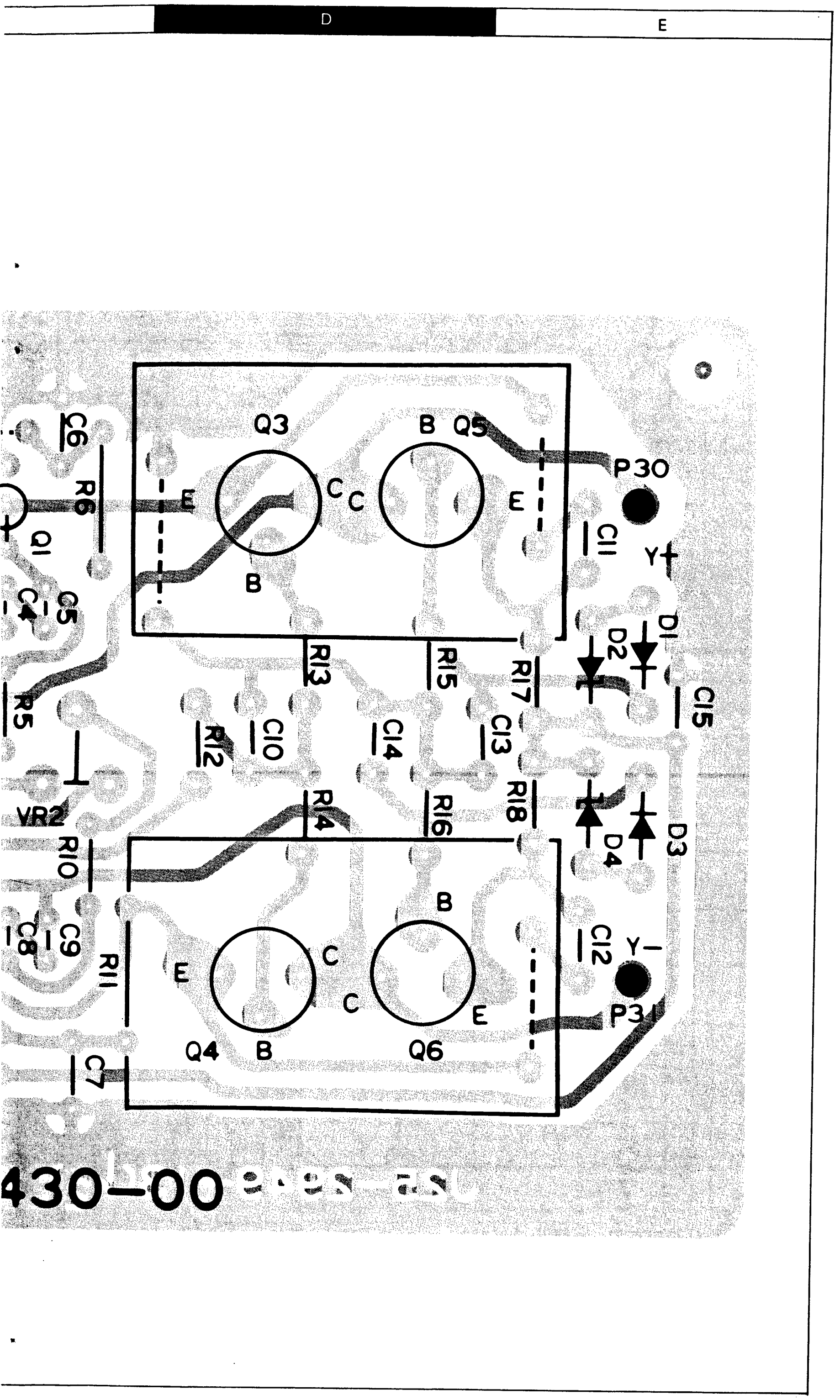

A
B
C
D
E
1
2
3
4
P17
1
J1
C6
P16
1
5
TC1
C1
R3
R6
Q1
Q3
B
Q5
C
C
E
E
B
P30
C11
Y+
R2
R4
C4
C5
R5
R13
R15
R17
D1
D2
C15
R12
C10
C14
C13
C16
VR1
VR2
R14
R16
R18
D3
D4
C17
R10
+
C18
C2
R8
R7
Q2
R9
C8
C9
R11
E
C
B
C
C12
Y−
C19
C3
J1
Q4
B
Q6
E
P31
C7
+
X73-1430-00

X73-1

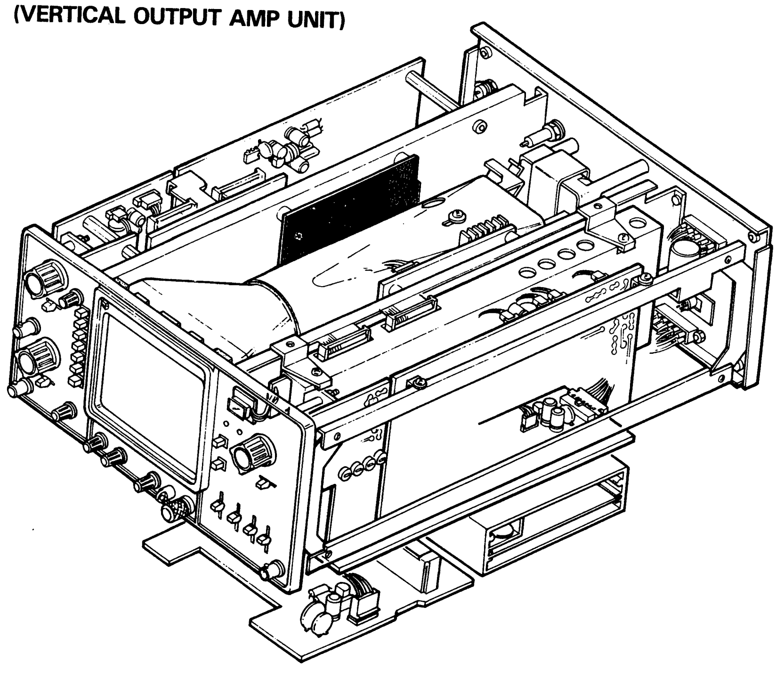
(VERTI



# BOARD


D
E
Q3
B
Q5
P30
C6
R6
E
C
C
E
Q1
C11
Y+
B
C5
C4
D1
D2
R13
R15
R17
C15
R5
R12
C10
C14
C13
VR2
R14
R16
R18
D4
D3
R10
B
C12
Y−
C8
C9
R11
E
C
C
E
P31
Q4
B
Q6
C7
430−00

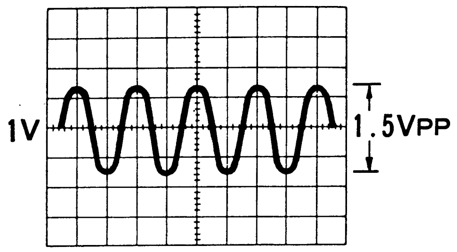
X73-1430-00
(VERTICAL OUTPUT AMP UNIT)



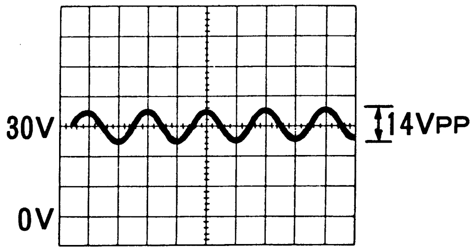
## WAVEFORM

**X73-1430-00**

①

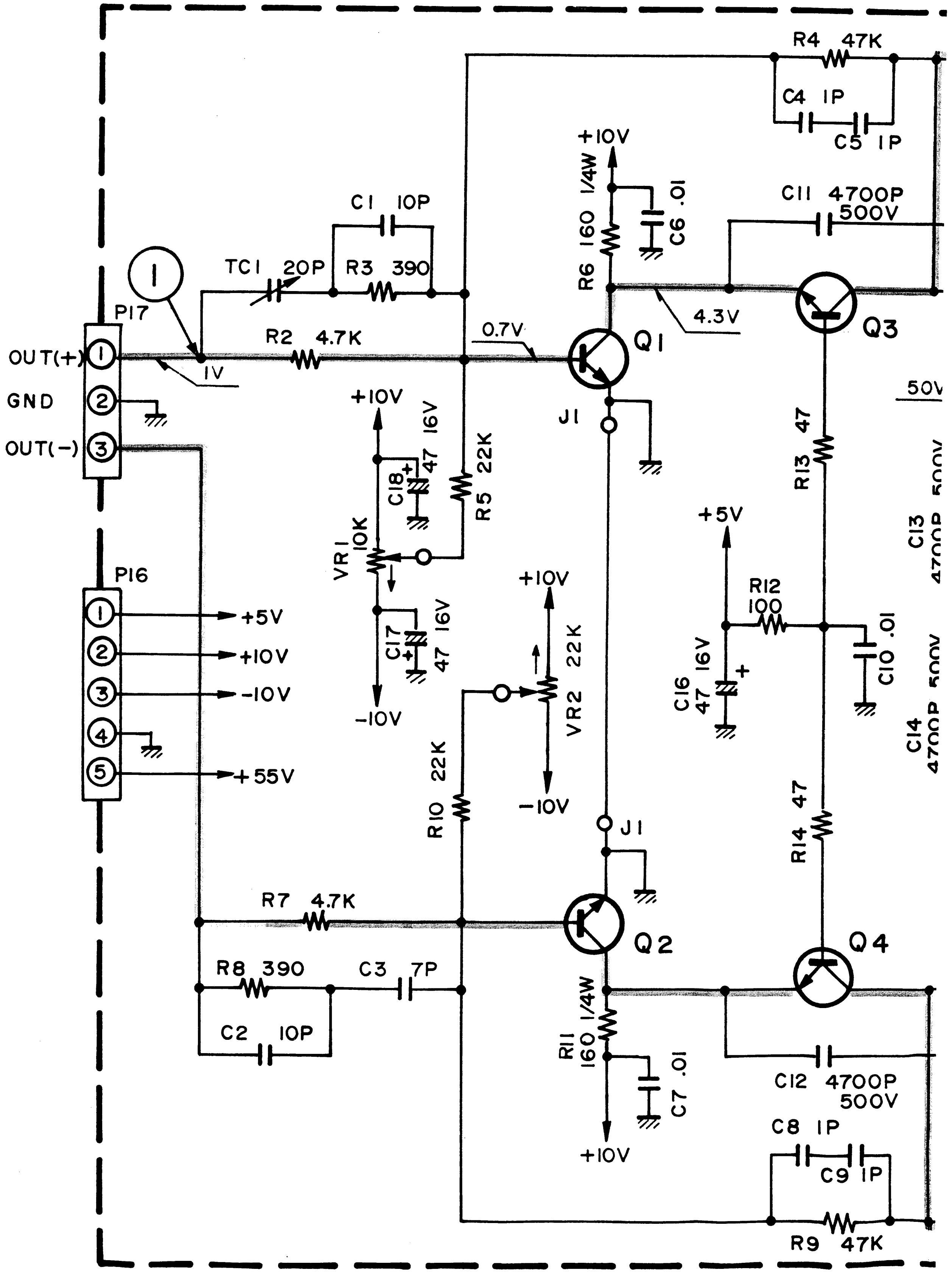


②



## SCHEMATIC I

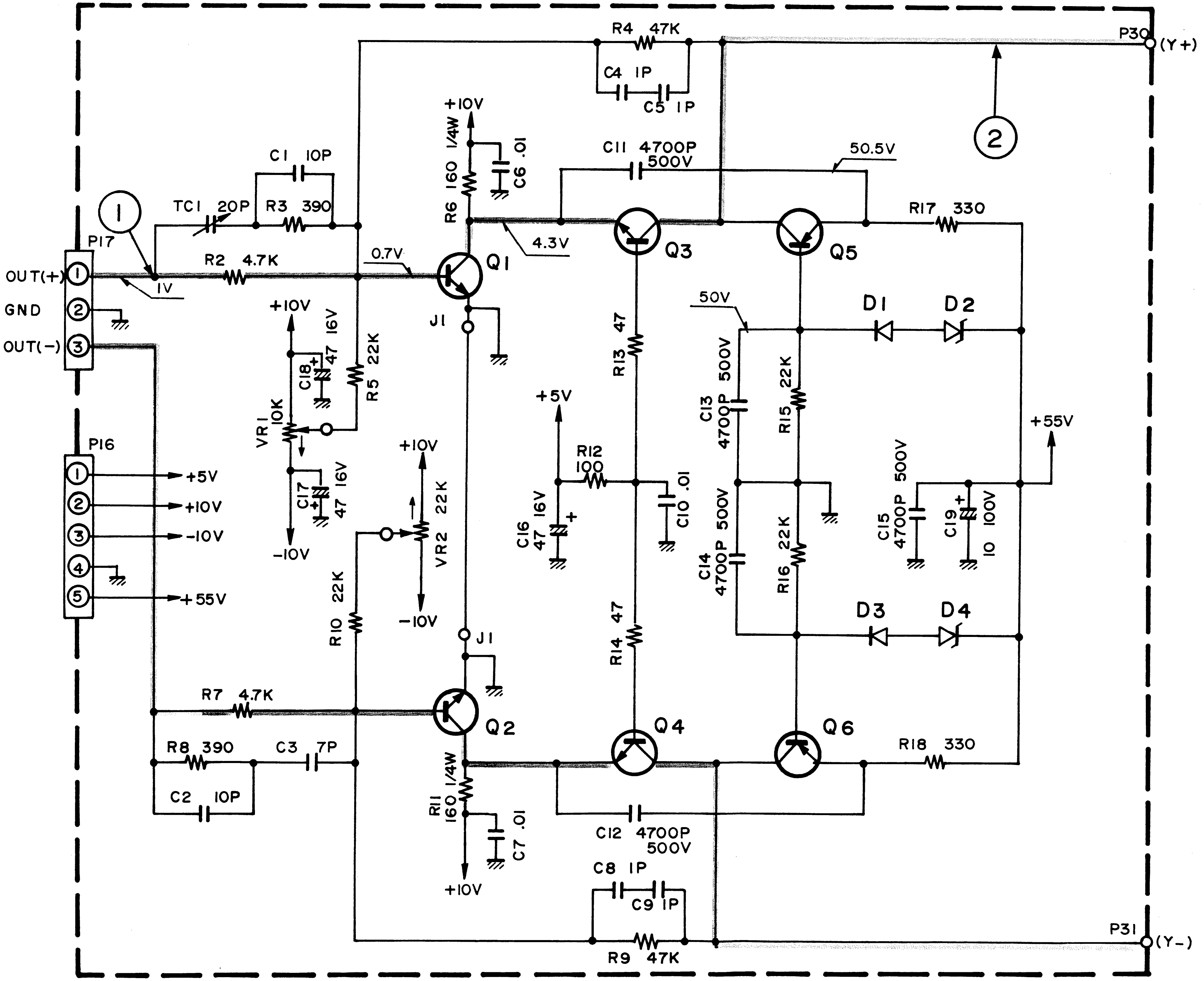
VERTICAL OUTPUT AMP UNIT (X73-1430-00)


P17
OUT(+) ①
GND ②
OUT(−) ③
①
1V
TC1 20P
C1 10P
R3 390
R2 4.7K
0.7V
Q1
+10V
R6 160 1/4W
C6 .01
4.3V
R4 47K
C4 1P
C5 1P
C11 4700P 500V
Q3
50V
J1
+10V
C18 47 16V
R5 22K
VR1 10K
C17 47 16V
−10V
R13 47
C13 4700P 500V
+5V
R12 100
C10 .01
C16 47 16V
C14 4700P 500V
+10V
VR2 22K
−10V
R10 22K
R14 47
P16
① +5V
② +10V
③ −10V
④
⑤ +55V
J1
R7 4.7K
Q2
Q4
R8 390
C3 7P
C2 10P
R11 160 1/4W
C7 .01
+10V
C12 4700P 500V
C8 1P
C9 1P
R9 47K

# SCHEMATIC DIAGRAM

**X73-1430-00**

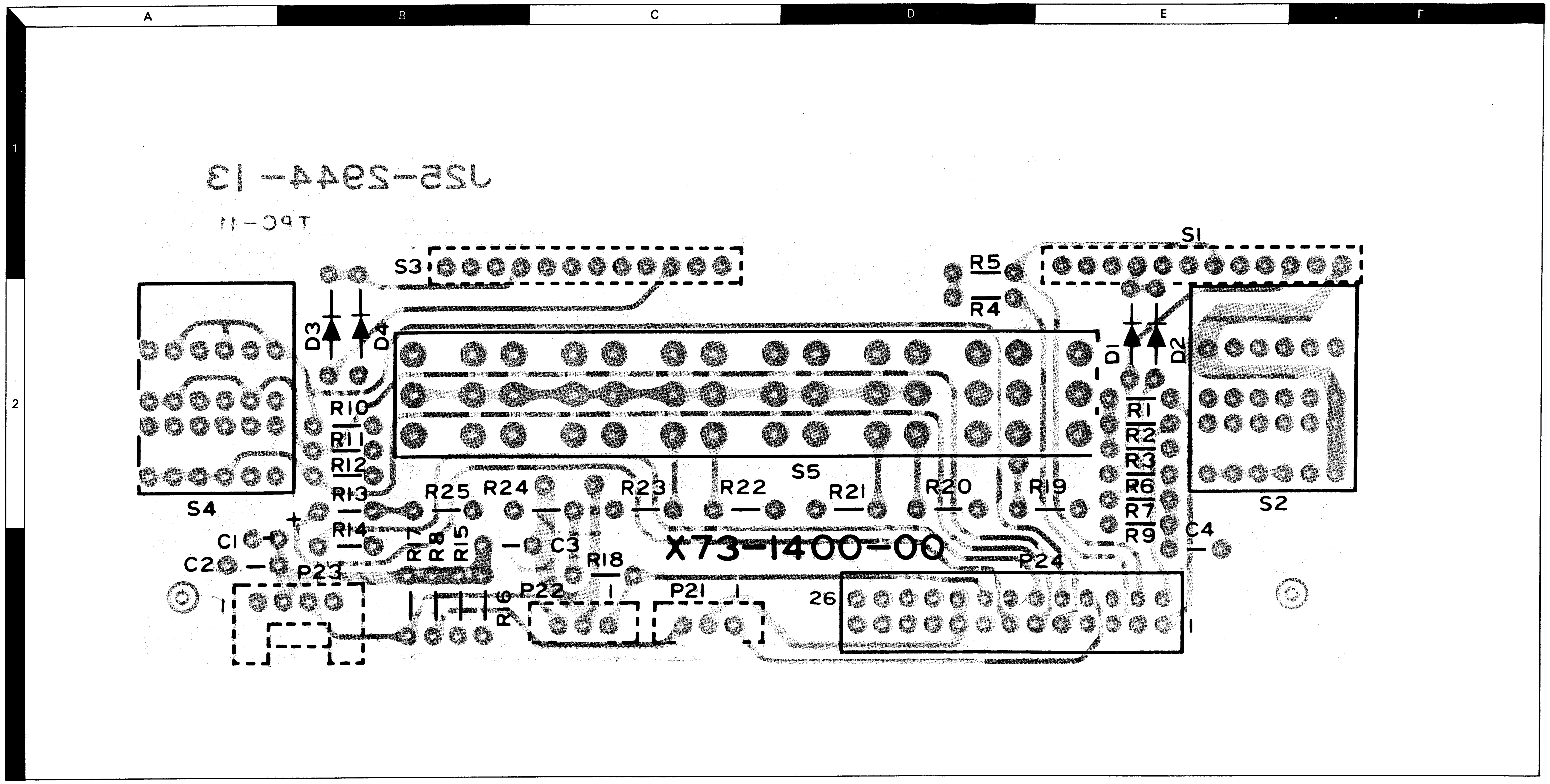
VERTICAL OUTPUT AMP UNIT (X73-1430-00)


R4 47K
C4 1P
C5 1P
P30
(Y+)
②
+10V
C1 10P
C11 4700P 500V
50.5V
R6 160 1/4W
C6 .01
①
TC1 20P
R3 390
R17 330
P17
R2 4.7K
0.7V
4.3V
Q1
Q3
Q5
OUT(+) ①
1V
GND ②
OUT(-) ③
J1
+10V
C18 47 16V
R5 22K
D1
D2
50V
R13 47
C13 4700P 500V
R15 22K
VR1 10K
+5V
+55V
P16
① +5V
② +10V
③ -10V
④
⑤ +55V
C17 47 16V
-10V
+10V
VR2 22K
R12 100
C16 47 16V
C10 .01
C14 4700P 500V
R16 22K
C15 4700P 500V
C19 10 100V
-10V
R10 22K
J1
D3
D4
R14 47
R7 4.7K
Q2
Q4
Q6
R8 390
C3 7P
R18 330
C2 10P
R11 160 1/4W
C7 .01
C12 4700P 500V
+10V
C8 1P
C9 1P
P31
(Y-)
R9 47K

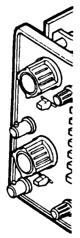
Q1,2 :2SC1973(T)
Q3,4 :2SC805A-2(3)
Q5,6 :2SA923-2(2,3)
D1,3 :DS442X
D2,4 :WZ-050

# P.C. BOARD

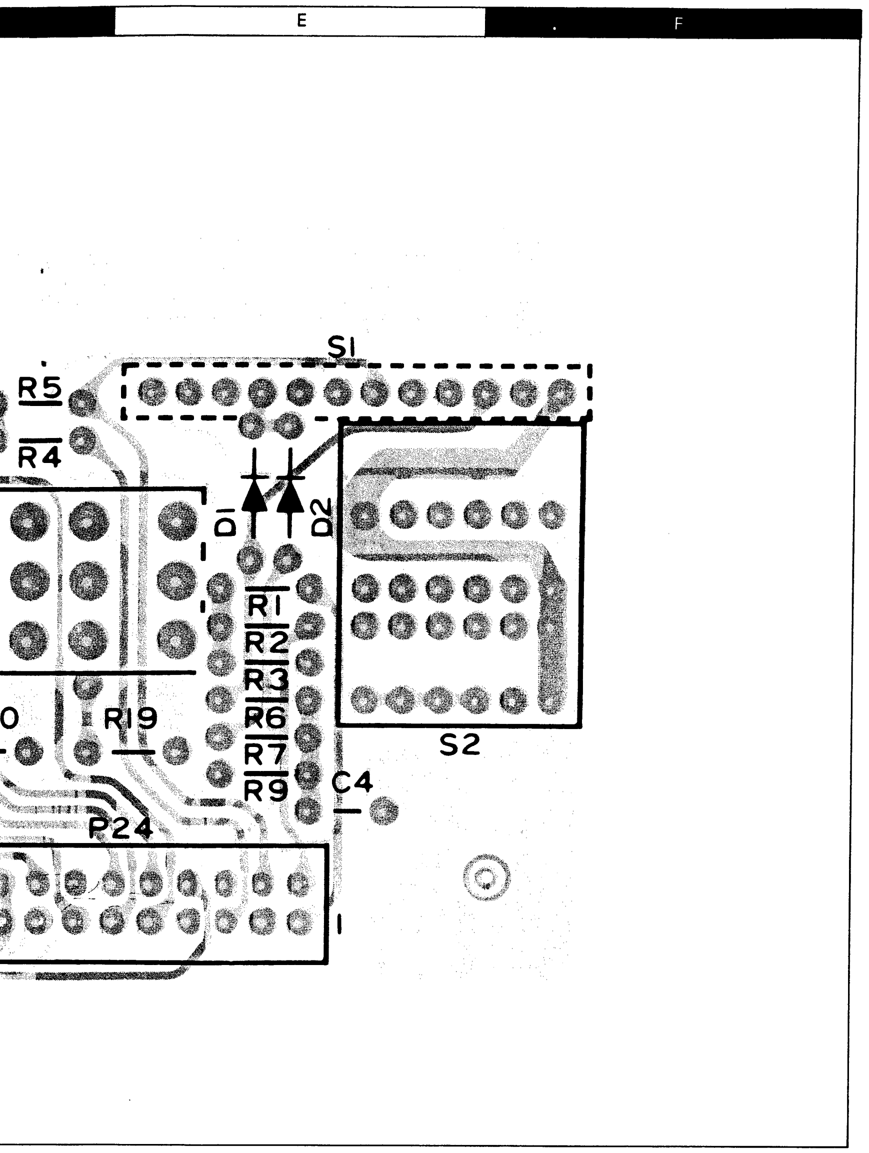
X73-1400-00

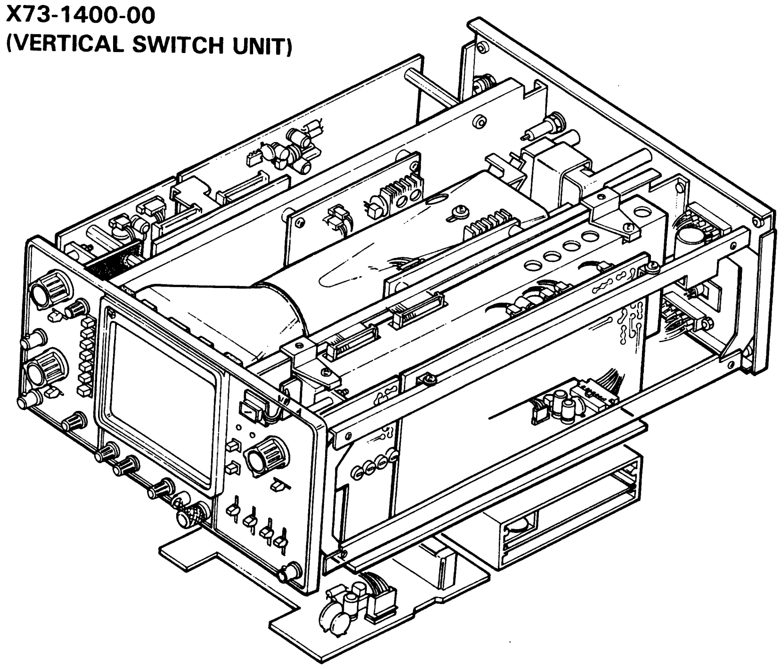

A
B
C
D
E
F
1
2
TPC-11
S3
S1
R5
R4
D3
D4
D1
D2
S4
S2
S5
R10
R11
R12
R13
R14
R25
R24
R23
R22
R21
R20
R19
R1
R2
R3
R6
R7
R9
C4
C1
C2
P23
R7
R8
R15
C3
R18
X73-1400-00
P24
R16
P22
P21
26
1

X73-14
(VERTIC



# ARD


E
F
S1
R5
R4
D1
D2
R1
R2
R3
R6
R7
R9
C4
S2
0
R19
P24
1

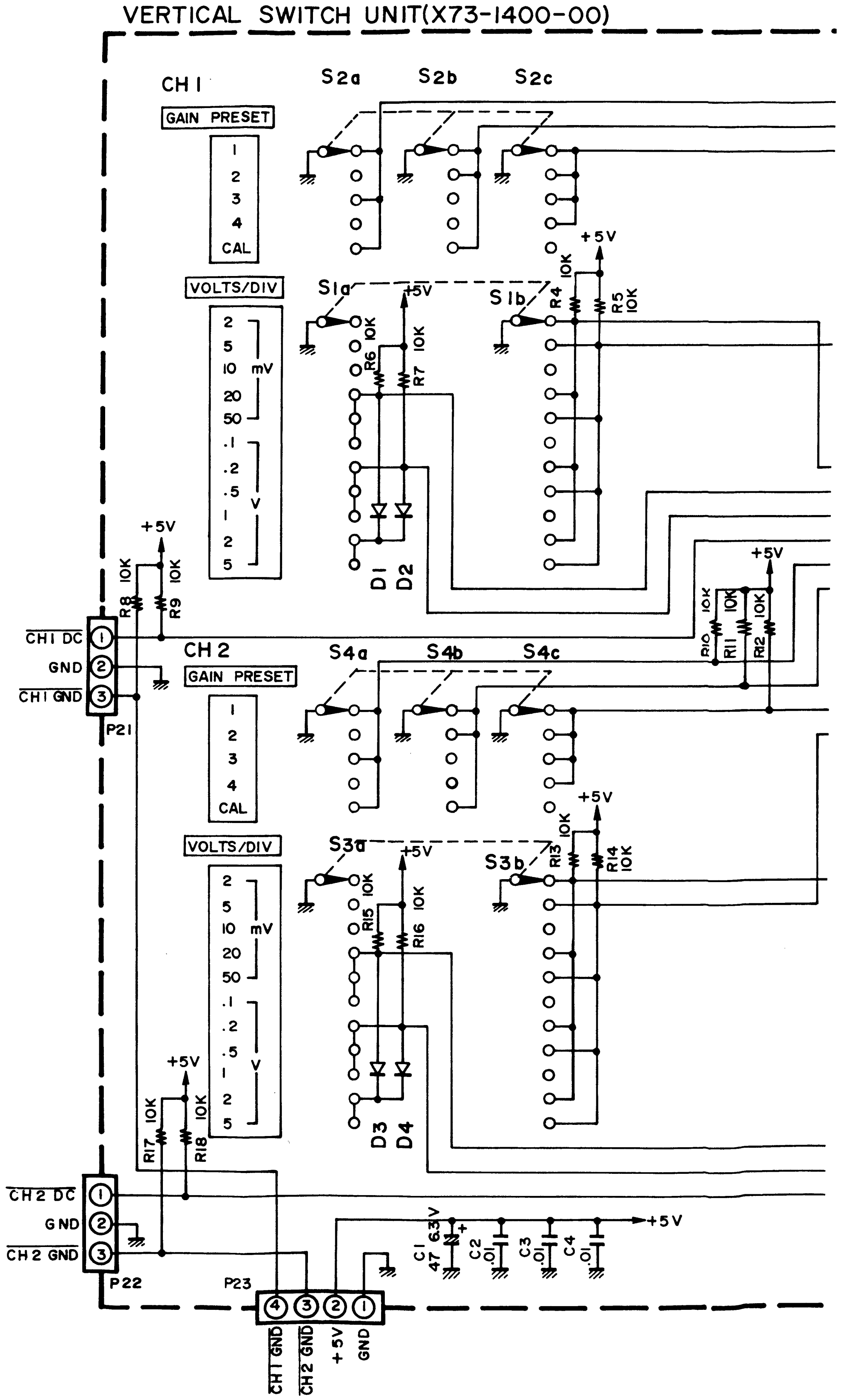


X73-1400-00
(VERTICAL SWITCH UNIT)

## WAVEFORM

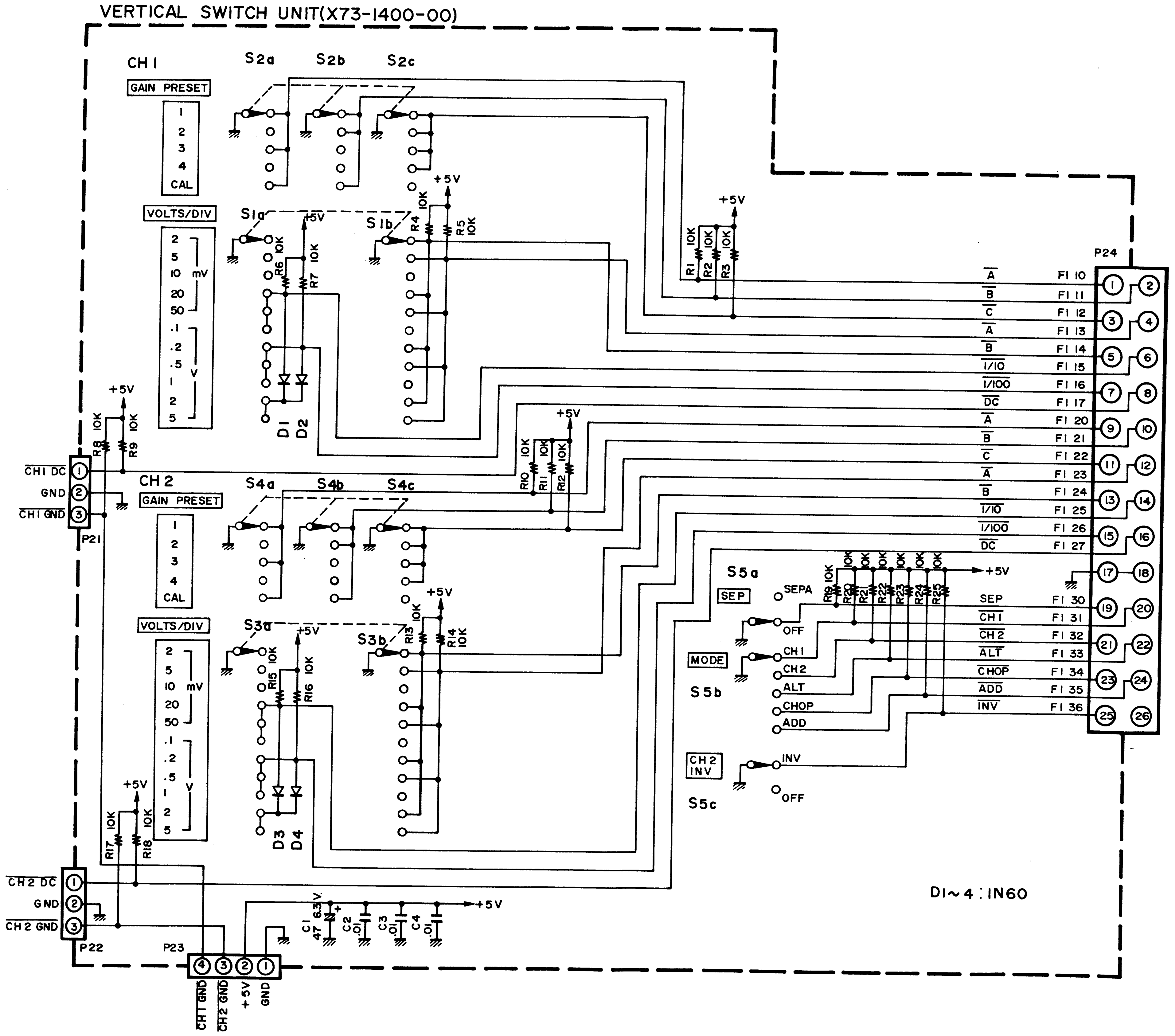
## SCHEMATIC DIA

### X73-1400-00


VERTICAL SWITCH UNIT(X73-1400-00)
CH I
GAIN PRESET
1
2
3
4
CAL
S2a
S2b
S2c
VOLTS/DIV
2
5
10 mV
20
50
.1
.2
.5
1 V
2
5
S1a
S1b
+5V
R4 10K
R5 10K
R6 10K
R7 10K
D1
D2
R8 10K
R9 10K
R10 10K
R11 10K
R12 10K
CHI DC
GND
CHI GND
P21
CH 2
GAIN PRESET
S4a
S4b
S4c
S3a
S3b
R13 10K
R14 10K
R15 10K
R16 10K
D3
D4
R17 10K
R18 10K
CH2 DC
GND
CH2 GND
P22
P23
C1 47 6.3V
C2 .01
C3 .01
C4 .01
CHI GND
CH2 GND
+5V
GND

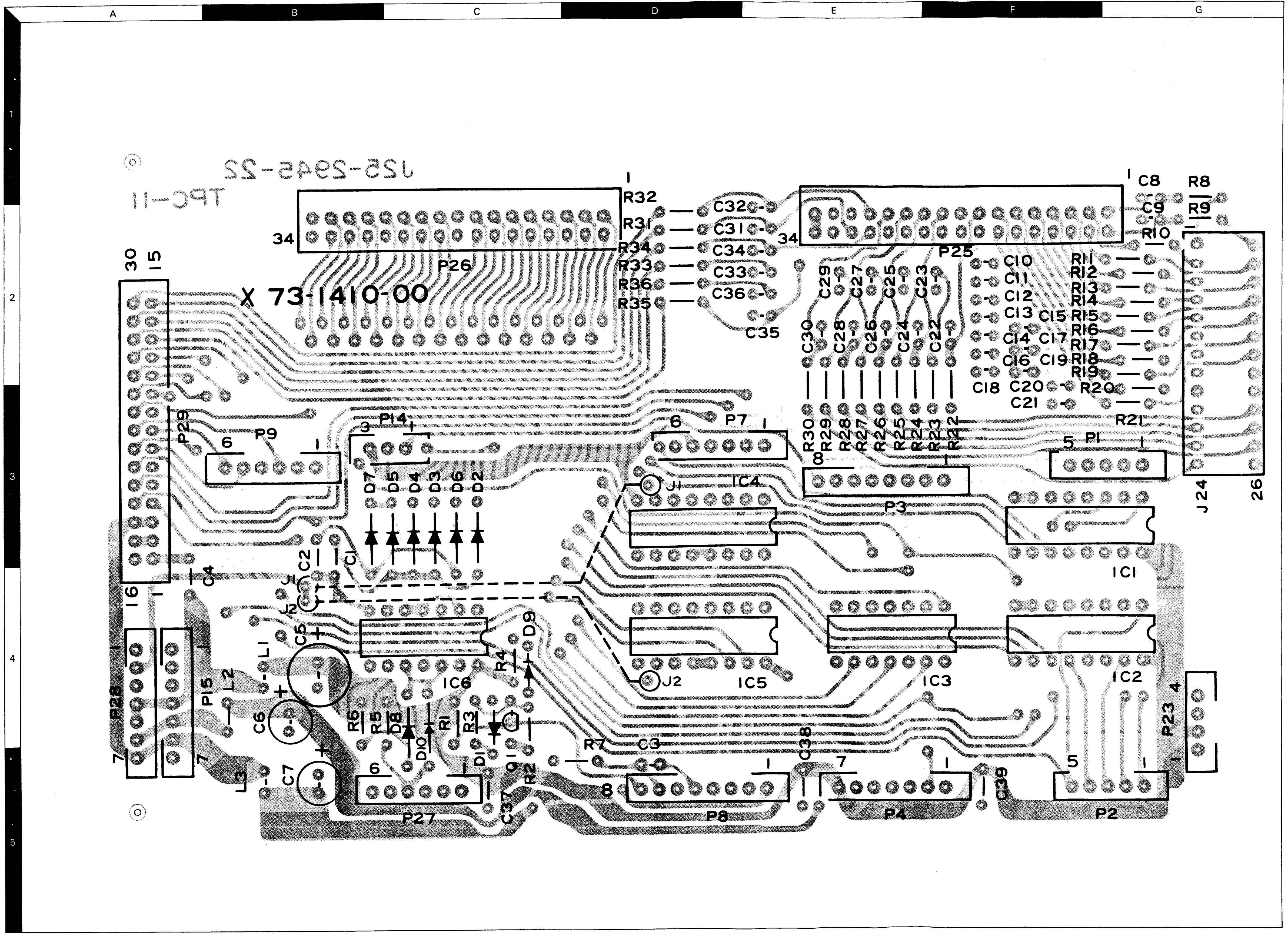
# SCHEMATIC DIAGRAM

**X73-1400-00**

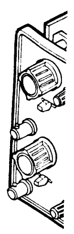

VERTICAL SWITCH UNIT(X73-1400-00)
CH I
GAIN PRESET
1
2
3
4
CAL
S2a
S2b
S2c
VOLTS/DIV
2
5
10 mV
20
50
.1
.2
.5 V
1
2
5
S1a
S1b
+5V
R4 10K
R5 10K
R6 10K
R7 10K
D1
D2
R1 10K
R2 10K
R3 10K
R8 10K
R9 10K
R10 10K
R11 10K
R12 10K
CH1 DC
GND
CH1 GND
P21
CH 2
S4a
S4b
S4c
S3a
S3b
R13 10K
R14 10K
R15 10K
R16 10K
D3
D4
R17 10K
R18 10K
CH2 DC
GND
CH2 GND
P22
P23
CH1 GND
CH2 GND
+5V
GND
C1 47 6.3V
C2 .01
C3 .01
C4 .01
P24
A F1 10
B F1 11
C F1 12
A F1 13
B F1 14
1/10 F1 15
1/100 F1 16
DC F1 17
A F1 20
B F1 21
C F1 22
A F1 23
B F1 24
1/10 F1 25
1/100 F1 26
DC F1 27
SEP F1 30
CH1 F1 31
CH2 F1 32
ALT F1 33
CHOP F1 34
ADD F1 35
INV F1 36
R19 10K
R20 10K
R21 10K
R22 10K
R23 10K
R24 10K
R25 10K
S5a
SEP
SEPA
OFF
MODE
CH1
CH2
ALT
CHOP
ADD
S5b
CH2 INV
INV
OFF
S5c
D1~4 : IN60

# P.C. BOARD

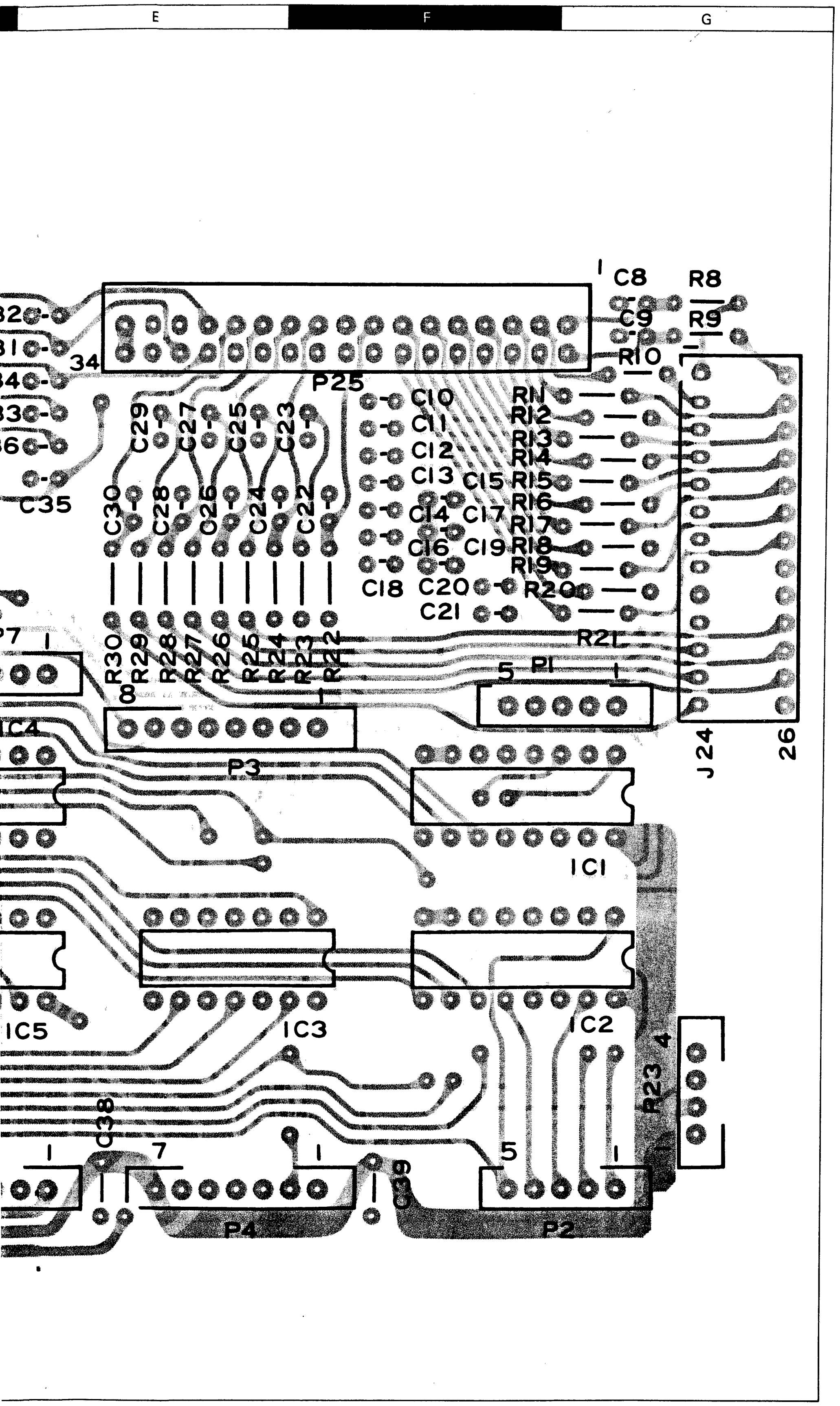
X73-1410-00

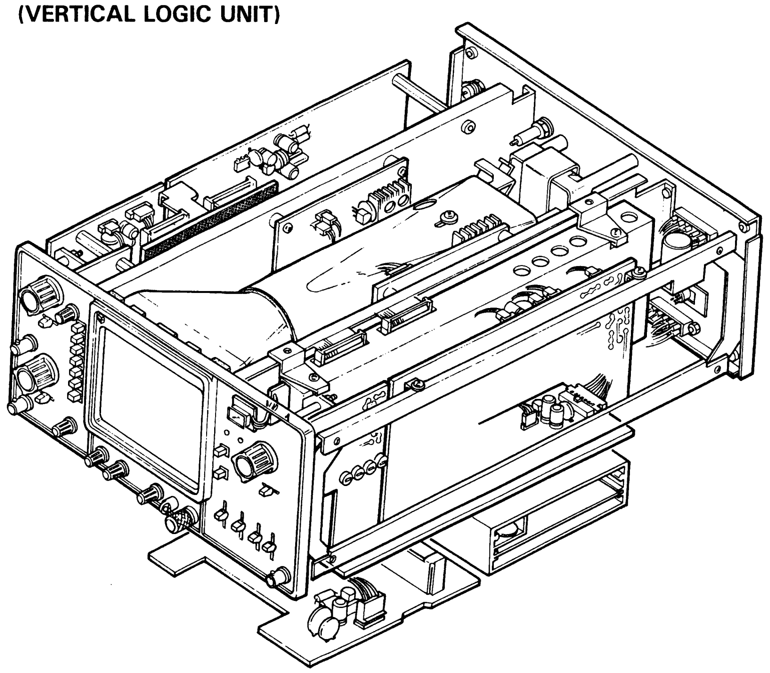

A
B
C
D
E
F
G
1
2
3
4
5
J25-2945-22
TPC-11
X 73-1410-00
P26
34
1
P25
34
R32
R31
R34
R33
R36
R35
C32
C31
C34
C33
C36
C35
C8
C9
R8
R9
R10
C10
C11
C12
C13
C14
C15
C16
C17
C18
C19
C20
C21
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
C22
C23
C24
C25
C26
C27
C28
C29
C30
R22
R23
R24
R25
R26
R27
R28
R29
R30
30
15
16
P29
P9
6
P14
3
D7
D5
D4
D3
D6
D2
C1
C2
C4
J1
J2
P7
6
IC4
P3
8
P1
5
J24
26
IC1
IC2
IC3
IC5
IC6
C5
C6
C7
L1
L2
L3
P15
P28
7
R1
R2
R3
R4
R5
R6
R7
D1
D8
D9
D10
Q1
C3
C37
C38
C39
P27
P8
P4
P2
P23
4

X73-
(VER



# BOARD

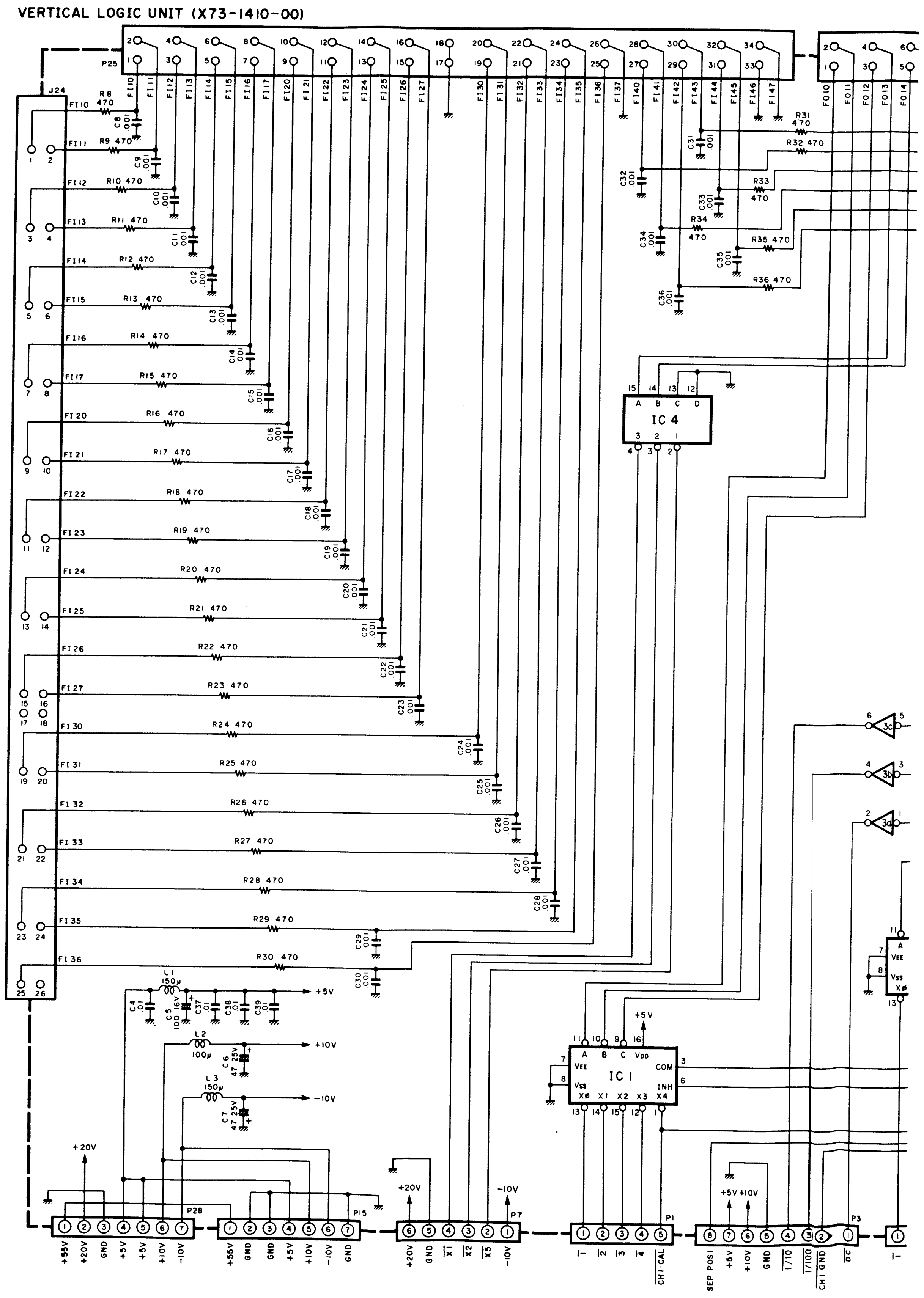

E
F
G
C8
R8
C9
R9
R10
34
P25
C10
C11
C12
C13
C14
C15
C16
C17
C18
C19
C20
C21
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
C22
C23
C24
C25
C26
C27
C28
C29
C30
C35
R22
R23
R24
R25
R26
R27
R28
R29
R30
P1
5
1
8
P3
J24
26
IC1
IC2
IC3
IC4
IC5
4
R23
C38
C39
7
P4
P2


X73-1410-00
(VERTICAL LOGIC UNIT)

# WAVEFORM

# SCHEMATIC

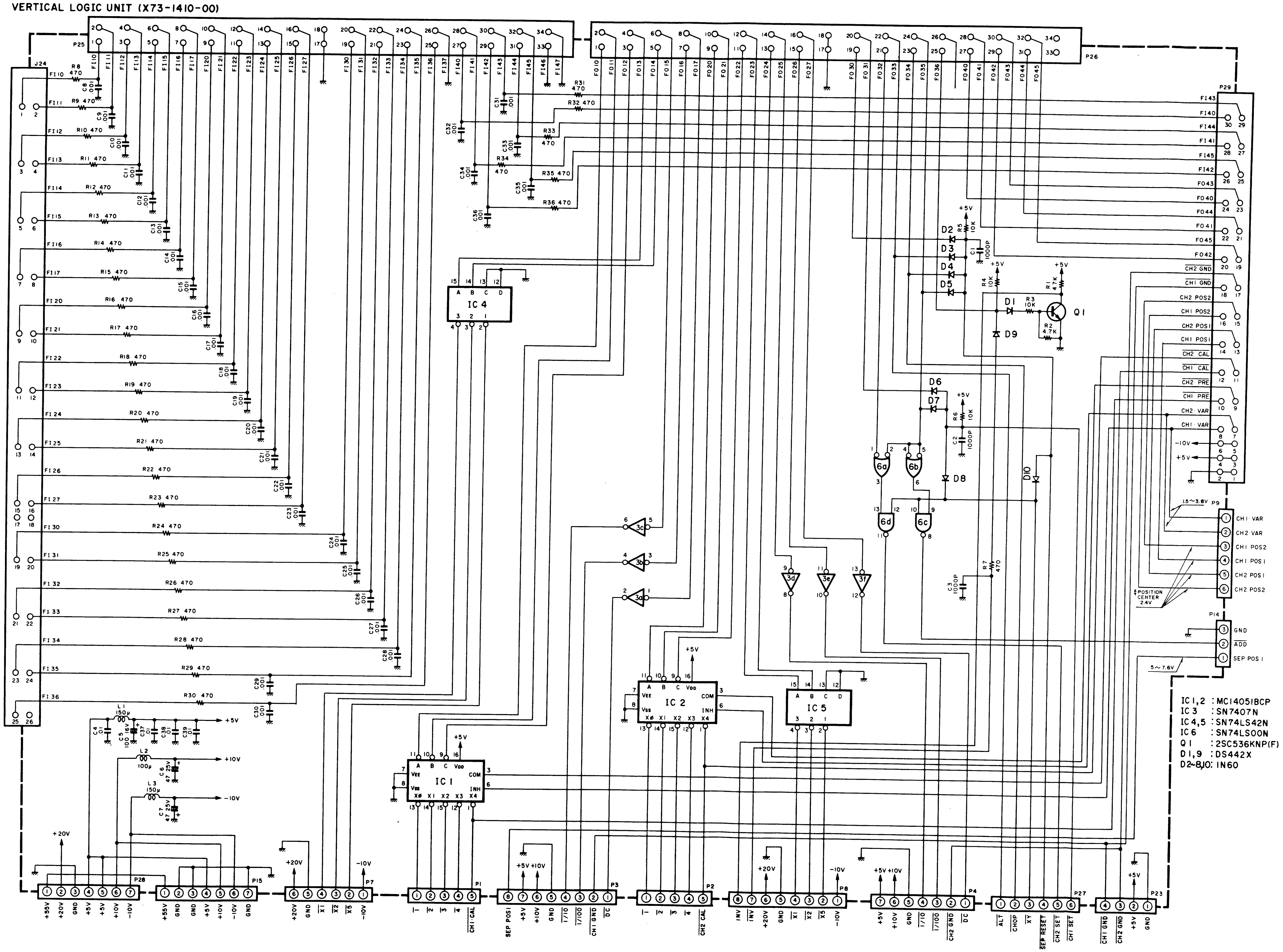
## X73-1410-00



VERTICAL LOGIC UNIT (X73-1410-00)
P25
J24
F110
F111
F112
F113
F114
F115
F116
F117
F120
F121
F122
F123
F124
F125
F126
F127
F130
F131
F132
F133
F134
F135
F136
F137
F140
F141
F142
F143
F144
F145
F146
F147
F010
F011
F012
F013
F014
R8 470
R9 470
R10 470
R11 470
R12 470
R13 470
R14 470
R15 470
R16 470
R17 470
R18 470
R19 470
R20 470
R21 470
R22 470
R23 470
R24 470
R25 470
R26 470
R27 470
R28 470
R29 470
R30 470
R31 470
R32 470
R33 470
R34 470
R35 470
R36 470
IC 4
IC 1
L1 150μ
L2 100μ
L3 150μ
+5V
+10V
-10V
+20V
P28
P15
P7
P1
P3
+55V
+20V
GND
+5V
+10V
-10V
X1
X2
X5
CH1 CAL
SEP POSI
1/10
1/100
CH1 GND
DC

# SCHEMATIC DIAGRAM

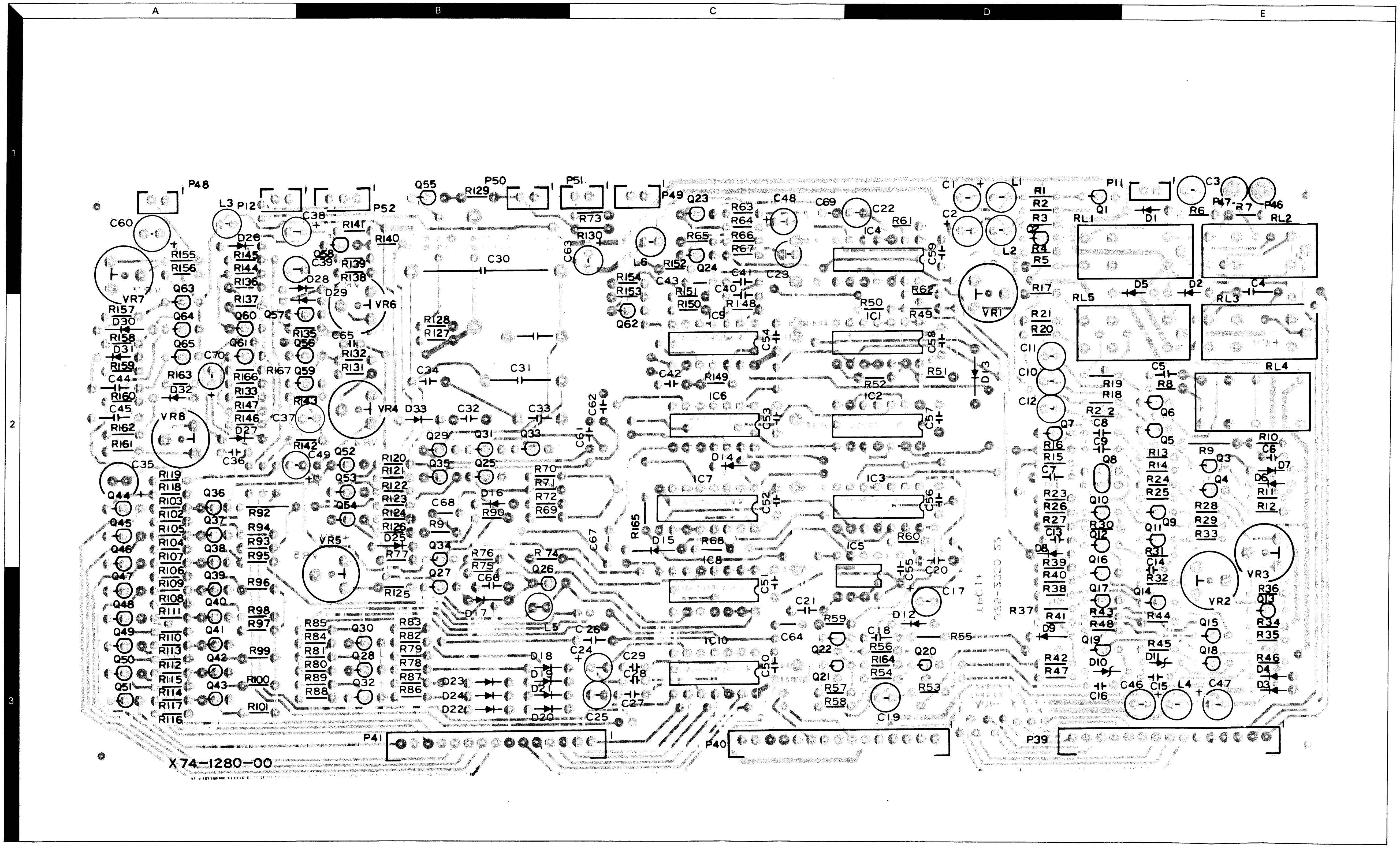
## X73-1410-00


VERTICAL LOGIC UNIT (X73-1410-00)
J24
P25
P26
P29
P9
P14
P28
P15
P7
P1
P3
P2
P8
P4
P27
P23
IC 1
IC 2
IC 4
IC 5
Q1
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
6a
6b
6c
6d
3a
3b
3c
3d
3e
3f
L1 150μ
L2 100μ
L3 150μ
R8 470
R31 470
R32 470
R33 470
R34 470
R35 470
R36 470
R1 4.7K
R2 4.7K
R3 10K
R4 10K
R5 10K
R6 10K
R7 470
C1 1000P
C2 1000P
C3 1000P
+5V
+10V
-10V
+20V
CH1 VAR
CH2 VAR
CH1 POS2
CH1 POS1
CH2 POS1
CH2 POS2
GND
ADD
SEP POS1
1.5~3.8V
5~7.6V
POSITION CENTER 2.4V
CH2 GND
CH1 GND
CH2 CAL
CH1 CAL
CH2 PRE
CH1 PRE
+55V
SEP POS1
1/10
1/100
DC
INV
X1
X2
X5
ALT
CHOP
XY
SEP RESET
CH2 SET
CH1 SET

IC1,2 : MC14051BCP
IC3 : SN7407N
IC4,5 : SN74LS42N
IC6 : SN74LS00N
Q1 : 2SC536KNP(F)
D1,9 : DS442X
D2~8,10: 1N60

# P.C. BOARD

X74-1280-00


A
B
C
D
E
1
2
3
X74-1280-00
P48
P12
P52
P50
P51
P49
P11
P41
P40
P39
L1
L2
L3
L4
L5
L6
VR1
VR2
VR3
VR4
VR5
VR6
VR7
VR8
RL1
RL2
RL3
RL4
RL5
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
C14
C15
C16
C17
C18
C19
C20
C21
C22
C23
C24
C25
C26
C27
C28
C29
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C38
C39
C40
C41
C42
C43
C44
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C48
C49
C50
C51
C52
C53
C54
C55
C56
C57
C58
C59
C60
C61
C62
C63
C64
C65
C66
C67
C68
C69
C70
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
D16
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D19
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D21
D22
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D26
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D28
D29
D30
D31
D32
D33
Q1
Q2
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Q4
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Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q17
Q18
Q19
Q20
Q21
Q22
Q23
Q24
Q25
Q26
Q27
Q28
Q29
Q30
Q31
Q32
Q33
Q34
Q35
Q36
Q37
Q38
Q39
Q40
Q41
Q42
Q43
Q44
Q45
Q46
Q47
Q48
Q49
Q50
Q51
Q52
Q53
Q54
Q55
Q56
Q57
Q58
Q59
Q60
Q61
Q62
Q63
Q64
Q65
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
R26
R27
R28
R29
R30
R31
R32
R33
R34
R35
R36
R37
R38
R39
R40
R41
R42
R43
R44
R45
R46
R47
R48
R49
R50
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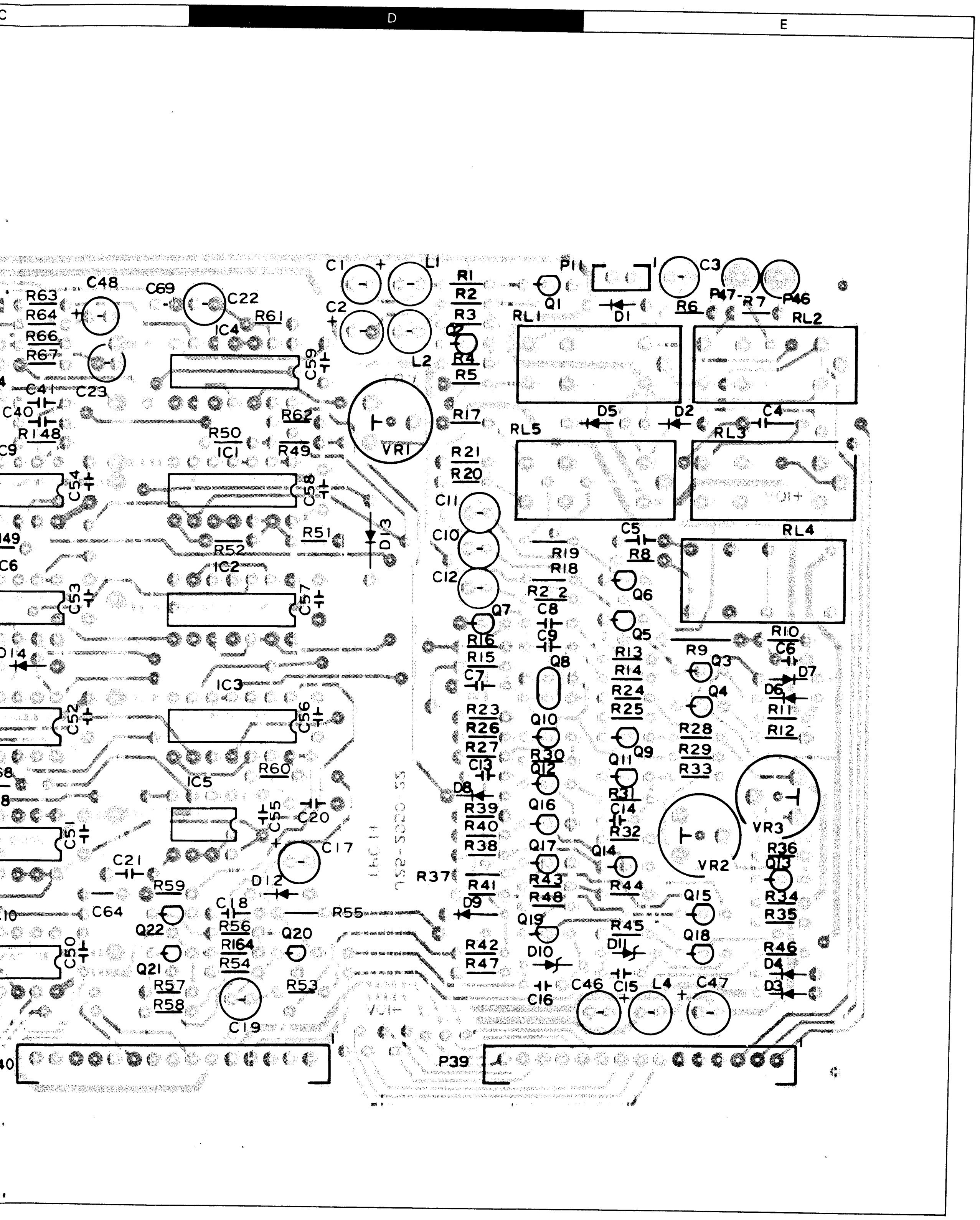
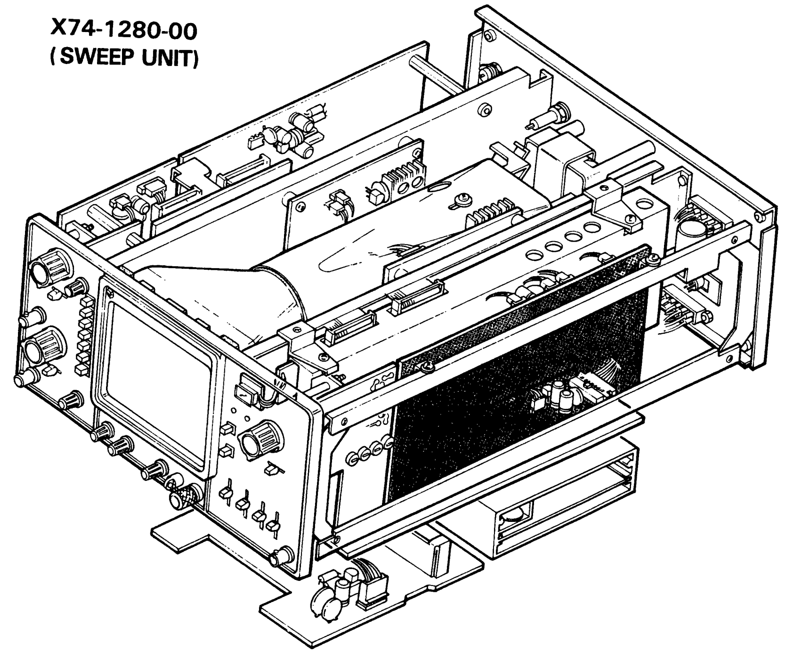
R52
R53
R54
R55
R56
R57
R58
R59
R60
R61
R62
R63
R64
R65
R66
R67
R68
R69
R70
R71
R72
R73
R74
R75
R76
R77
R78
R79
R80
R81
R82
R83
R84
R85
R86
R87
R88
R89
R90
R91
R92
R93
R94
R95
R96
R97
R98
R99
R100
R101
R102
R103
R104
R105
R106
R107
R108
R109
R110
R111
R112
R113
R114
R115
R116
R117
R118
R119
R120
R121
R122
R123
R124
R125
R126
R127
R128
R129
R130
R131
R132
R133
R135
R136
R137
R138
R139
R140
R141
R142
R143
R144
R145
R146
R147
R148
R149
R150
R151
R152
R153
R154
R155
R156
R157
R158
R159
R160
R161
R162
R163
R164
R165
R166
R167

# C. BOARD


C
D
E
C1
C2
L1
L2
R1
R2
R3
R4
R5
Q1
Q2
P11
D1
C3
R6
R47
R7
R46
RL1
RL2
C48
C69
C22
R63
R64
R66
R67
R61
IC4
C23
C59
C41
C40
R148
VR1
R17
R62
R50
IC1
R49
D5
D2
C4
RL5
RL3
R21
R20
C54
C58
D13
C11
C10
C12
R51
R52
IC2
C5
R8
RL4
R19
R18
R22
C8
C9
Q7
Q6
Q5
C53
C57
R16
R15
C7
Q8
R13
R14
R9
Q3
R10
C6
D7
D6
D14
IC3
R24
R25
Q4
R11
R12
C52
C56
R23
R26
R27
Q10
R30
Q12
R28
R29
R33
Q9
Q11
C13
D8
IC5
R60
C55
C20
R39
R40
R38
Q16
Q17
R31
C14
R32
VR3
VR2
C51
C17
R37
R43
R48
Q14
R44
R36
Q13
R34
R35
C21
R59
D12
C18
C64
R55
D9
R41
Q15
Q22
R56
Q20
Q19
R45
Q18
R164
R54
D11
C50
Q21
R42
R47
D10
R46
D4
D3
R57
R58
R53
C16
C46
C15
L4
C47
C19
P40
P39

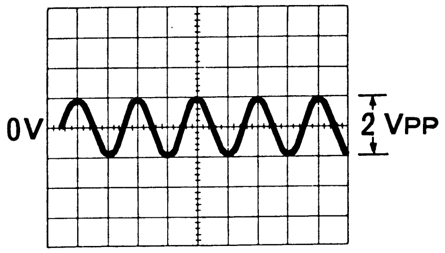
**X74-1280-00**
**(SWEEP UNIT)**



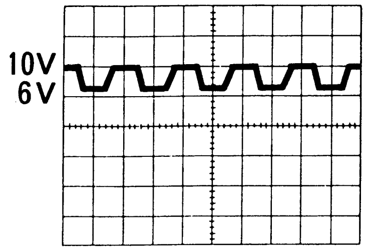
## WAVEFORM

X74-1280-00

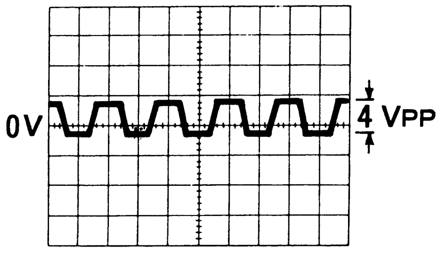
① ②



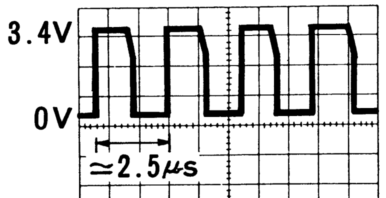
③ ④



⑤ ⑥

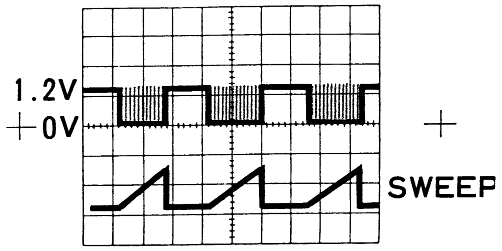


⑦

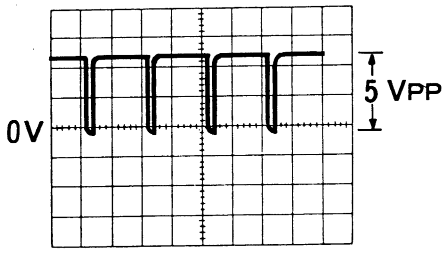


MODE:CHOP

⑧

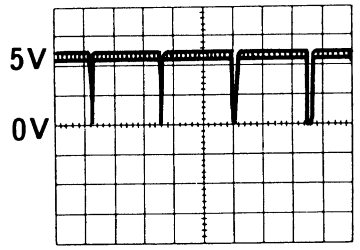


⑨−1



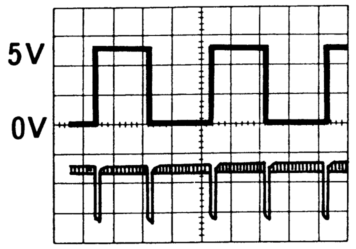
VIDEO LINE

⑨−2



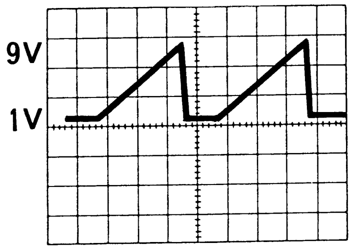
VIDEO FRAME

⑩

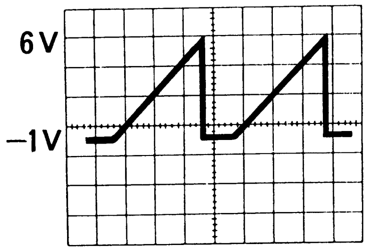


VIDEO FRAME

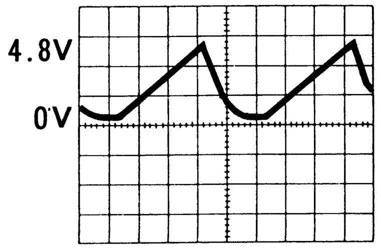
⑪



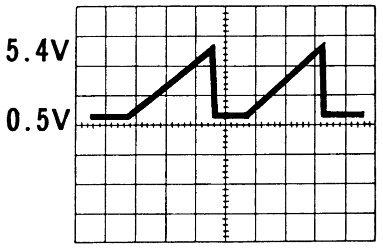
⑫



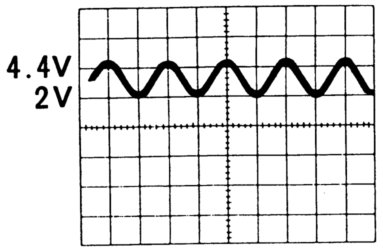
⑬



⑭−1

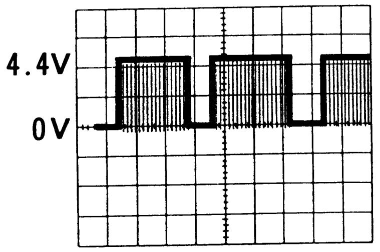


⑭−2



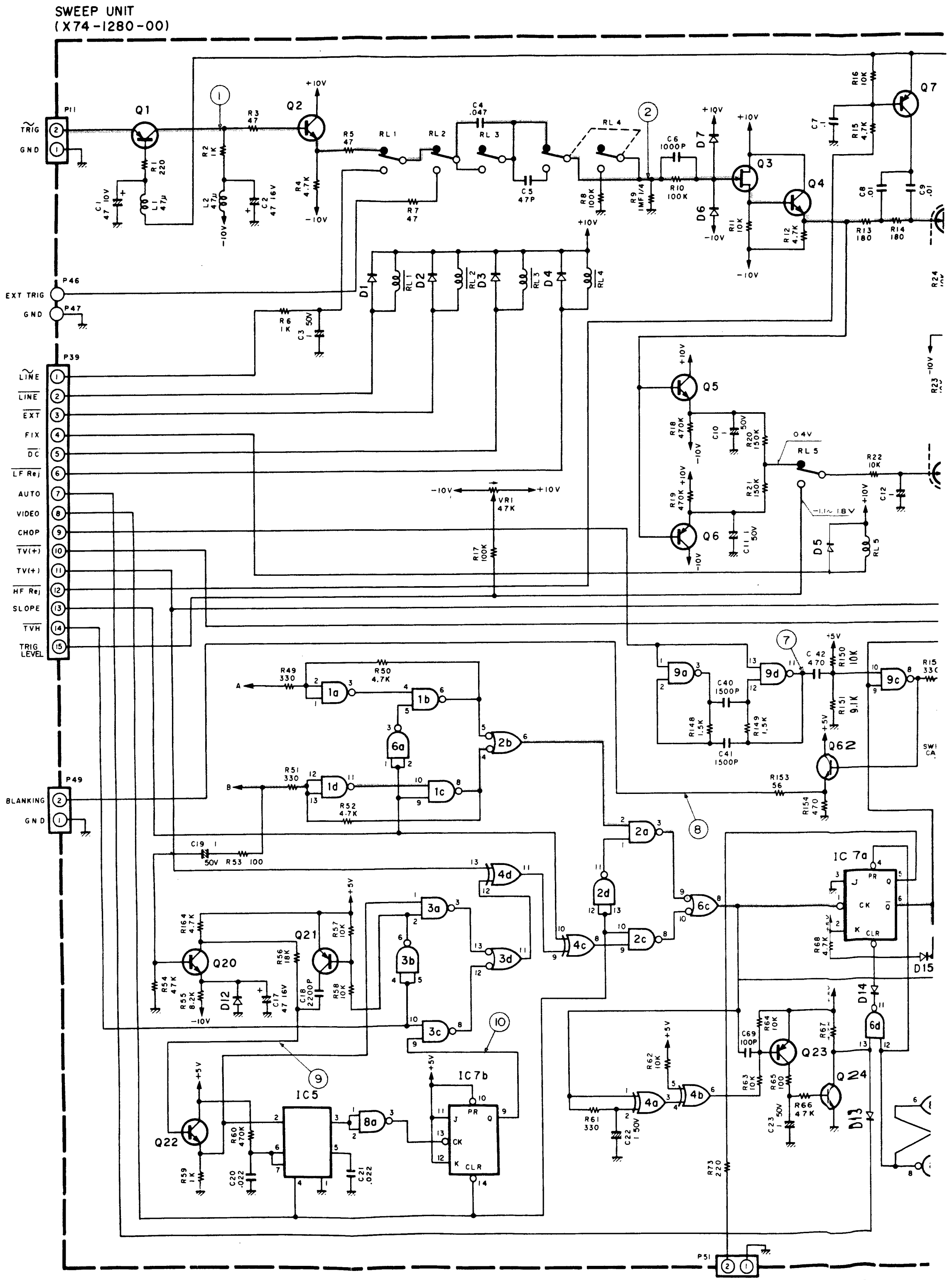
XY

⑮



NOTE: ▥ CHOP OPERATION

## SCHEMATIC DI


SWEEP UNIT
(X74-1280-00)
P11
TRIG
GND
P46
EXT TRIG
GND
P47
P39
LINE
LINE
EXT
FIX
DC
LF Rej
AUTO
VIDEO
CHOP
TV(+)
TV(−)
HF Rej
SLOPE
TVH
TRIG LEVEL
P49
BLANKING
GND
P51
SWP GATE
GND
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q20
Q21
Q22
Q23
Q24
Q62
RL1
RL2
RL3
RL4
RL5
VR1 47K
IC5
IC 7a
IC7b
+10V
−10V
+5V

D1∼5,8,9,12,14,16∼29,31∼33 :DS442X
D6,7 :IS1544A
D10,11 :WZ-061
D13,15,30 :IN60

Q1 :2SA838(C)
Q2,4,9∼12,14∼19,56∼58 :2SC1047(C)
Q3 :2SK107(2,3)
Q5,13,20,22,24,27,29,31,33 44∼51,54 :2SC536KNP(F)

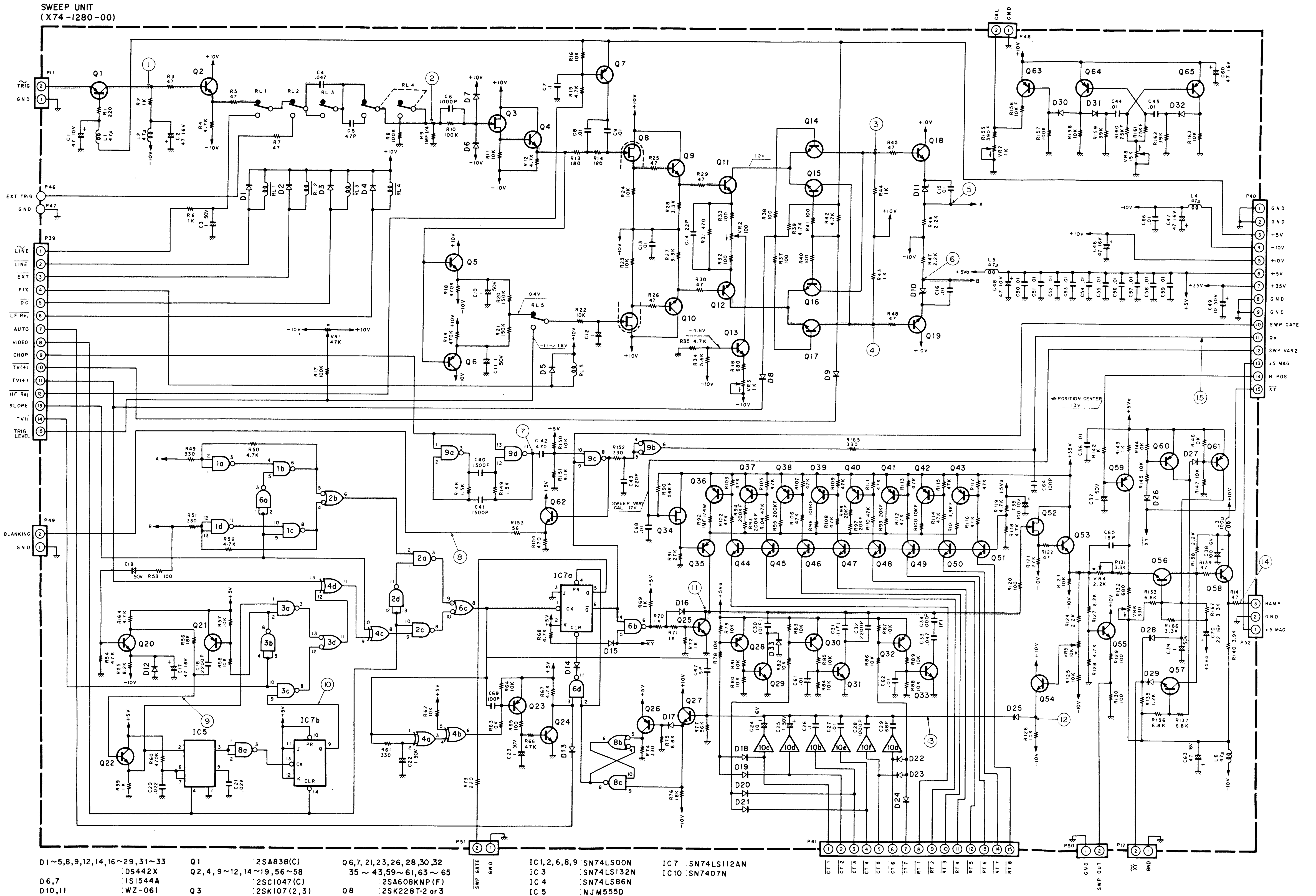
Q6,7,21,23,26,28,30,32 35∼43,59∼61,63∼65 :2SA608KNP(F)
Q8 :2SK228T-2 or 3
Q25,53,55,62 :2SC1973(T)
Q34,52 :2SK30A(O)

IC1,2,6 ,8,9 :SN74LS
IC 3 :SN74LS
IC 4 :SN74LS
IC 5 :NJM55

# SCHEMATIC DIAGRAM

X74-1280-00

5 VPP


SWEEP UNIT
(X74-1280-00)
P11
TRIG
GND
P46
EXT TRIG
GND
P47
P39
LINE
LINE
EXT
FIX
DC
LF REJ
AUTO
VIDEO
CHOP
TV(+)
TV(-)
HF REJ
SLOPE
TVH
TRIG LEVEL
P49
BLANKING
GND
P48
CAL
GND
P40
GND
GND
+5V
-10V
+10V
+5V
+35V
GND
GND
SWP GATE
Qo
SWP VAR2
x5 MAG
H POS
XY
P52
RAMP
GND
x5 MAG
P51
SWP GATE
GND
P41
CT 1
CT 2
CT 3
CT 4
CT 5
CT 6
CT 7
RT 1
RT 2
RT 3
RT 4
RT 5
RT 6
RT 7
RT 8
P50
GND
SWP OUT
P12
XY
GND
IC5
IC7a
IC7b
SWEEP VAR CAL 17V
POSITION CENTER 1.3V

ON

D1~5,8,9,12,14,16~29,31~33
:DS442X
D6,7 :1S1544A
D10,11 :WZ-061
D13,15,30 :1N60

Q1 :2SA838(C)
Q2,4,9~12,14~19,56~58
:2SC1047(C)
Q3 :2SK107(2,3)
Q5,13,20,22,24,27,29,31,33
44~51,54 :2SC536KNP(F)

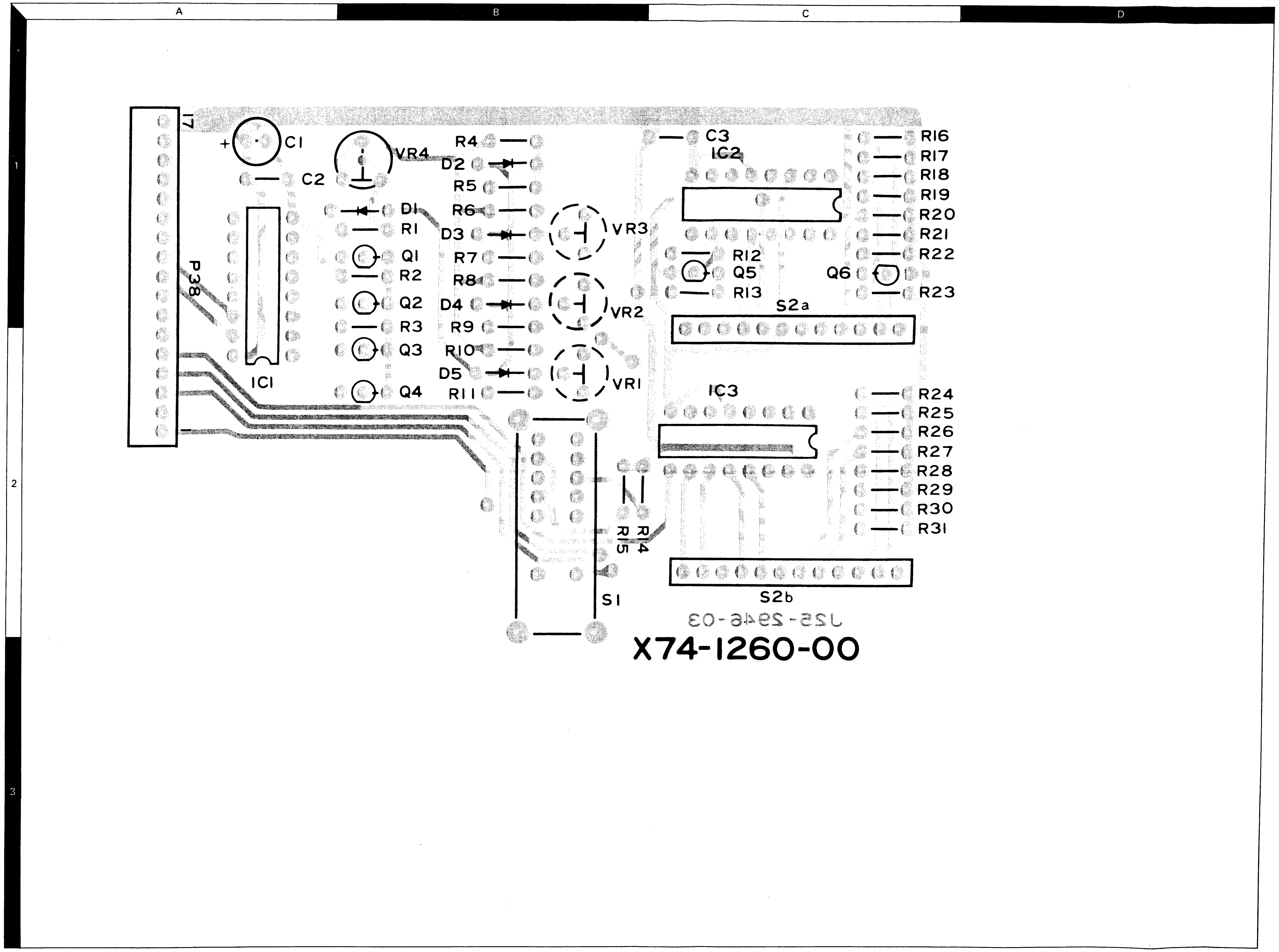
Q6,7,21,23,26,28,30,32
35 ~ 43,59~61,63~65
:2SA608KNP(F)
Q8 :2SK228T-2 or 3
Q25,53,55,62
:2SC1973(T)
Q34,52 :2SK30A(O)

IC1,2,6,8,9 :SN74LS00N
IC3 :SN74LS132N
IC4 :SN74LS86N
IC5 :NJM555D

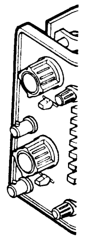
IC7 :SN74LS112AN
IC10 :SN7407N

# P.C. BOARD

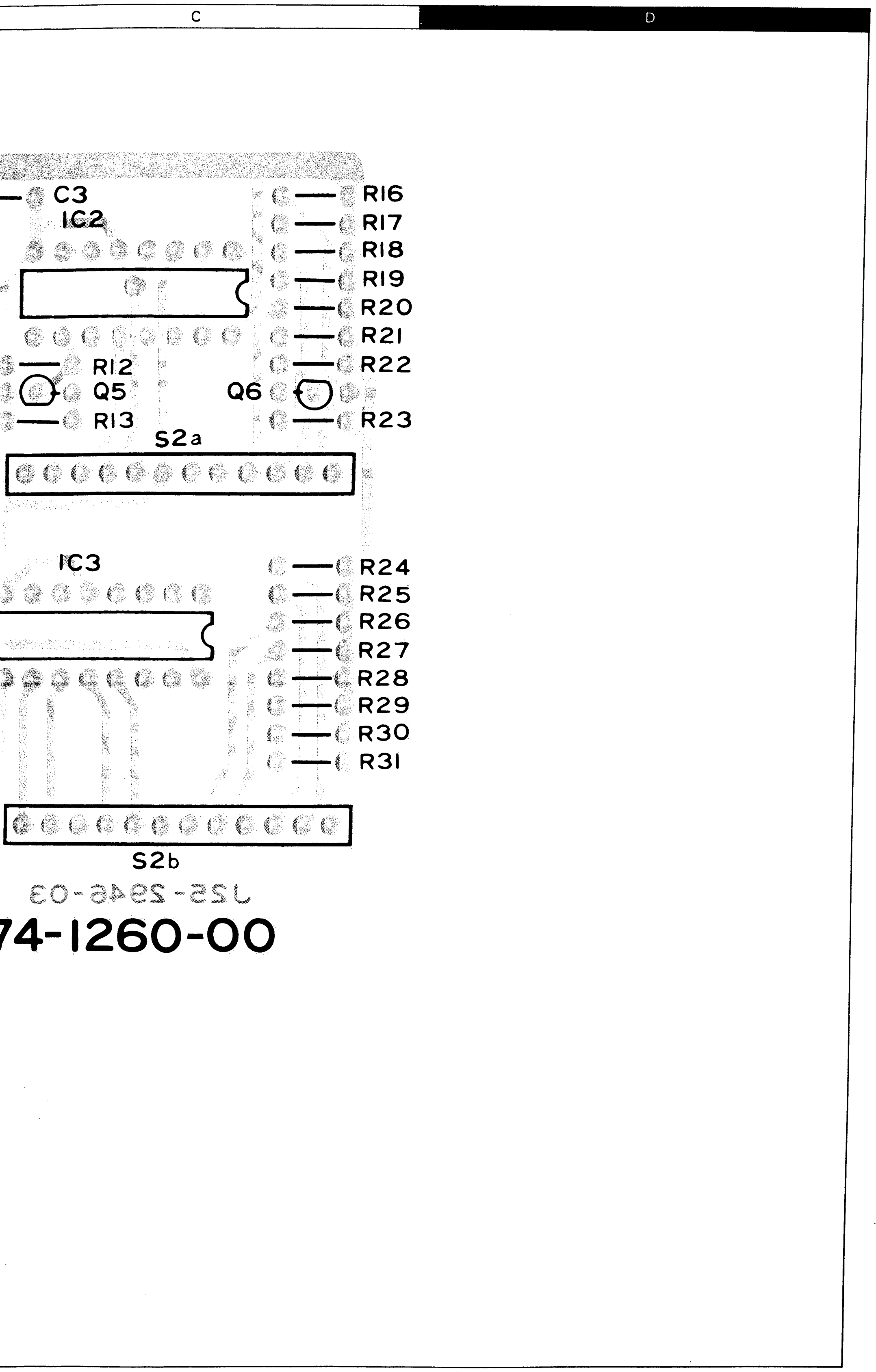
X74-1260-00

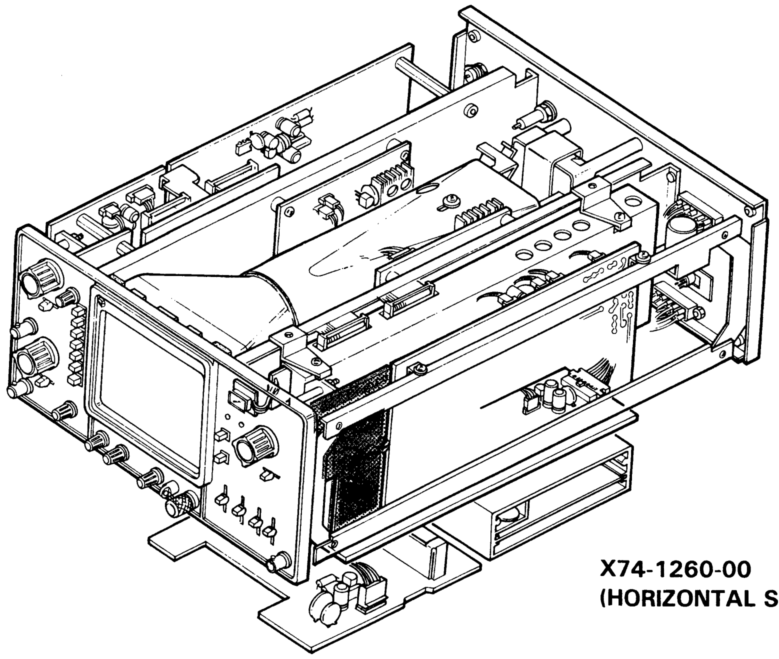


A
B
C
D
1
2
3
J7
C1
C2
VR4
R4
D2
R5
R6
D3
R7
R8
D4
R9
R10
D5
R11
D1
R1
Q1
R2
Q2
R3
Q3
Q4
IC1
P38
VR3
VR2
VR1
C3
IC2
R12
Q5
R13
Q6
S2a
R16
R17
R18
R19
R20
R21
R22
R23
IC3
R24
R25
R26
R27
R28
R29
R30
R31
R14
R15
S1
S2b
J25-2946-03
X74-1260-00



## P.C. BOARD


C
D
C3
IC2
R16
R17
R18
R19
R20
R21
R22
R12
Q5
Q6
R13
R23
S2a
IC3
R24
R25
R26
R27
R28
R29
R30
R31
S2b
74-1260-00

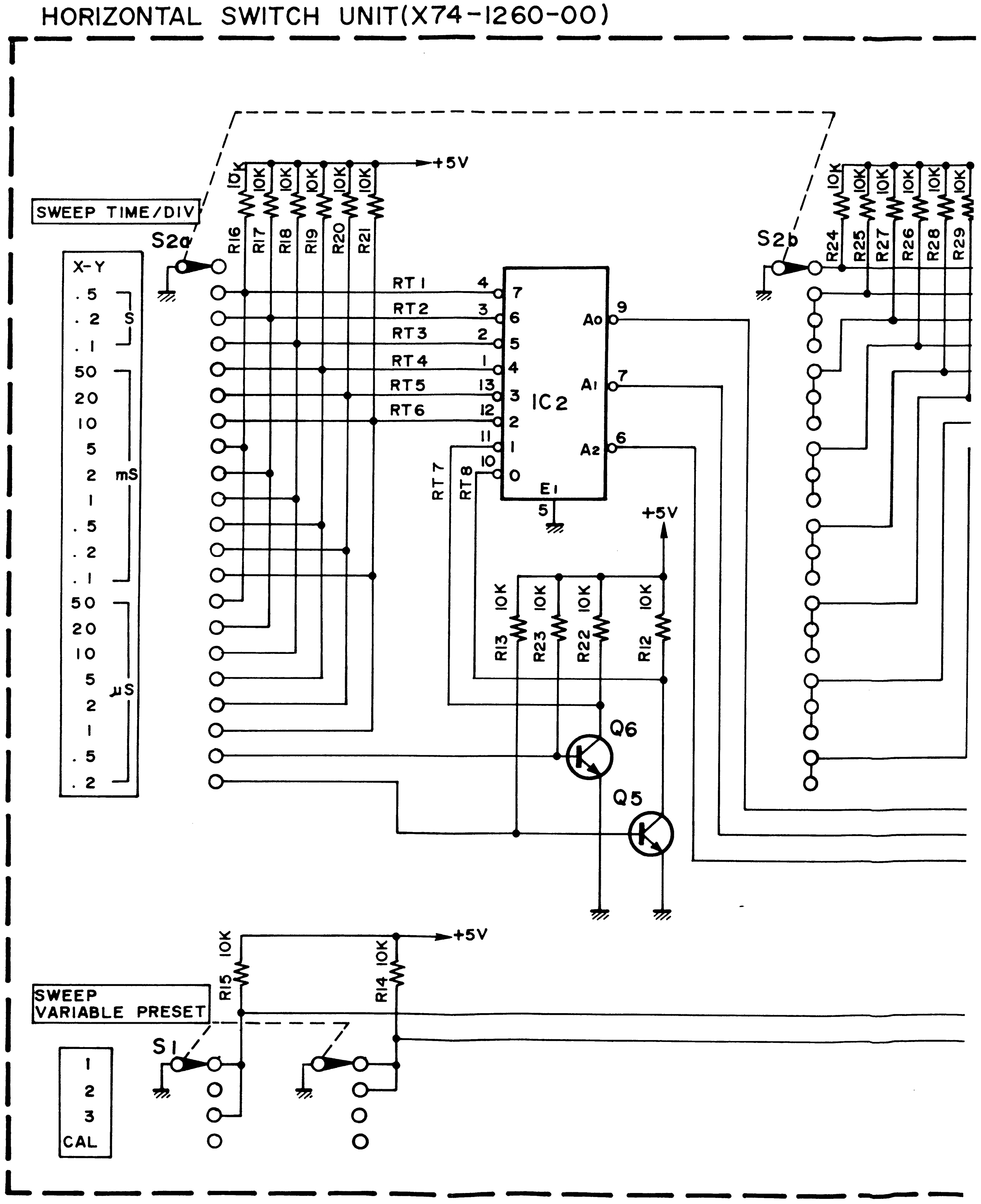


X74-1260-00
(HORIZONTAL SWITCH UNIT)

## WAVEFORM

## SCHEMATIC DIA

X74-1260-00

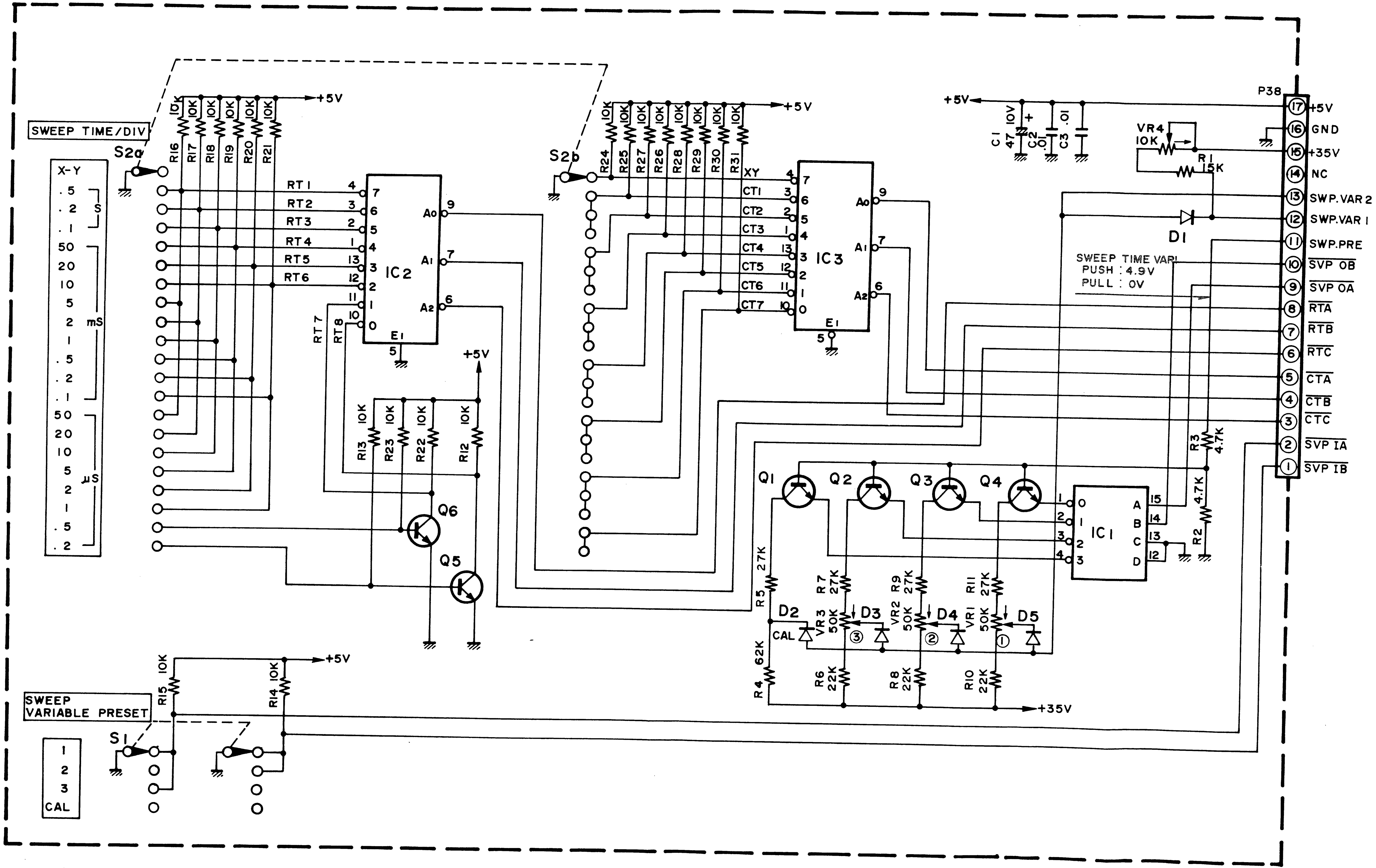

HORIZONTAL SWITCH UNIT(X74-1260-00)
SWEEP TIME/DIV
S2a
S2b
X-Y
.5
.2
.1
S
50
20
10
5
2
mS
1
.5
.2
.1
50
20
10
5
2
µS
1
.5
.2
+5V
10K
R16
R17
R18
R19
R20
R21
R24
R25
R27
R26
R28
R29
RT1
RT2
RT3
RT4
RT5
RT6
RT7
RT8
IC2
A0
A1
A2
E1
R13
R23
R22
R12
Q6
Q5
SWEEP VARIABLE PRESET
S1
1
2
3
CAL
R15
R14

Q1~6 :2SC536KNP(F)  IC1 :SN74LS42N  IC2,3 :SN74LS148N  D1

# SCHEMATIC DIAGRAM

X74-1260-00

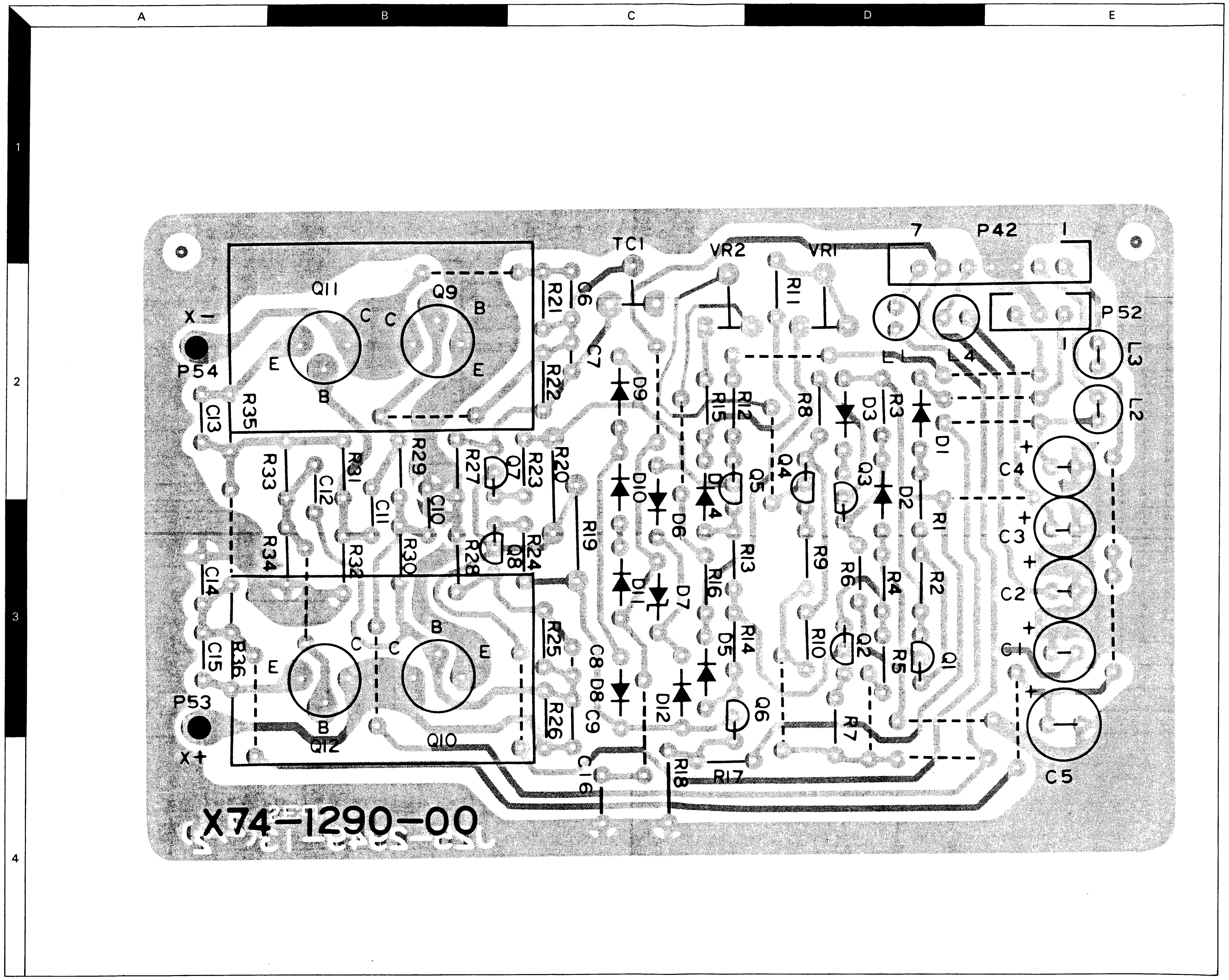
HORIZONTAL SWITCH UNIT(X74-1260-00)


SWEEP TIME/DIV
S2a
S2b
X-Y
.5
.2
.1
S
50
20
10
5
2
1
mS
µS
+5V
10K
R16
R17
R18
R19
R20
R21
RT1
RT2
RT3
RT4
RT5
RT6
RT7
RT8
IC2
IC3
IC1
A0
A1
A2
E1
R24
R25
R27
R26
R28
R29
R30
R31
XY
CT1
CT2
CT3
CT4
CT5
CT6
CT7
R13
R23
R22
R12
Q6
Q5
Q1
Q2
Q3
Q4
C1
47 10V
C2 .01
C3 .01
VR4
10K
R1
15K
D1
P38
+35V
GND
NC
SWP.VAR 2
SWP.VAR 1
SWP.PRE
SVP 0B
SVP 0A
RTA
RTB
RTC
CTA
CTB
CTC
SVP IA
SVP IB
SWEEP TIME VARI
PUSH : 4.9V
PULL : 0V
R3
4.7K
R2
4.7K
R5
27K
R7
27K
R9
27K
R11
27K
D2
D3
D4
D5
CAL
VR3
VR2
VR1
50K
R4
62K
R6
22K
R8
22K
R10
22K
SWEEP VARIABLE PRESET
S1
1
2
3
CAL
R15
R14

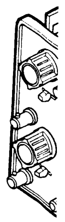
Q1~6 :2SC536KNP(F)  IC1 :SN74LS42N  IC2,3 :SN74LS148N  D1~5 :DS442X

# P.C. BOARD

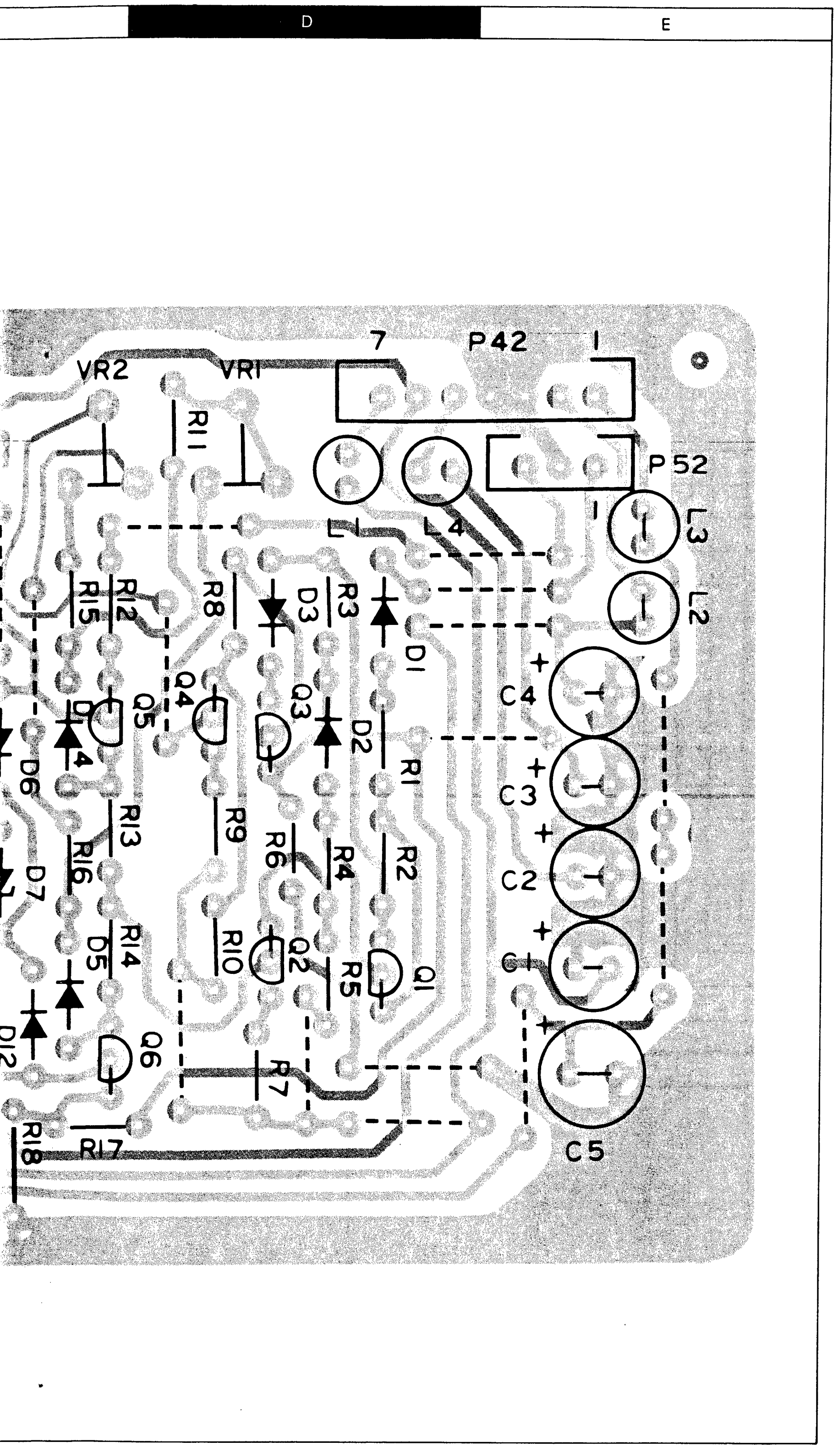
X74-1290-00


A
B
C
D
E
1
2
3
4
TC1
VR2
VR1
7
P42
1
P52
1
Q11
Q9
C
C
B
E
E
B
X−
P54
R21
C6
C7
R22
R11
L1
L4
L3
L2
C13
R35
D9
R15
R12
R8
D3
R3
D1
R33
C12
R31
R29
R27
Q7
R23
R20
D10
D6
D4
Q5
Q4
Q3
D2
C4
R1
C11
C10
R19
C3
R34
R32
R30
R28
Q8
R24
R13
R9
R6
R4
R2
C14
D11
D7
R16
C2
R25
R14
D5
R10
Q2
R5
Q1
C1
C15
R36
C
E
C
B
E
C8
D8
C9
D12
Q6
R7
P53
B
Q12
Q10
R26
C16
R18
R17
C5
X+
X74-1290-00

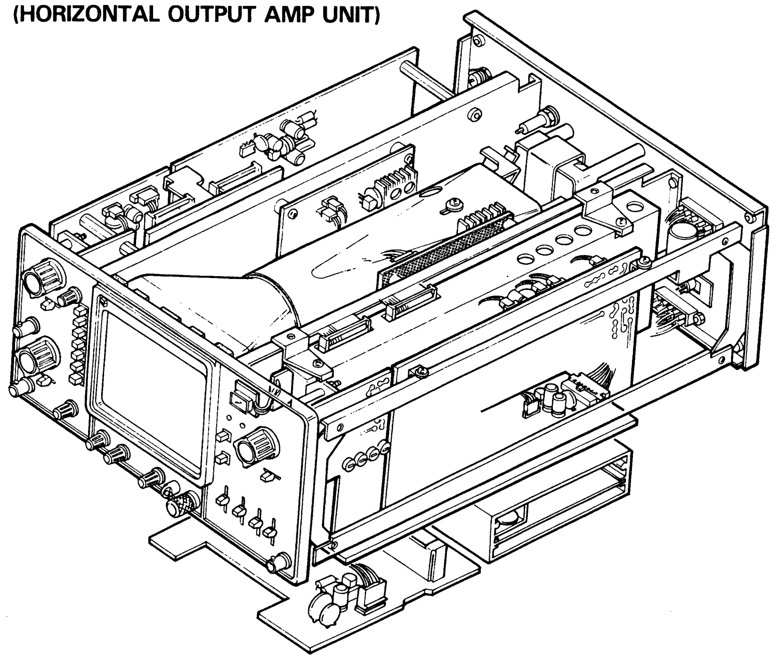
X74-
(HOR



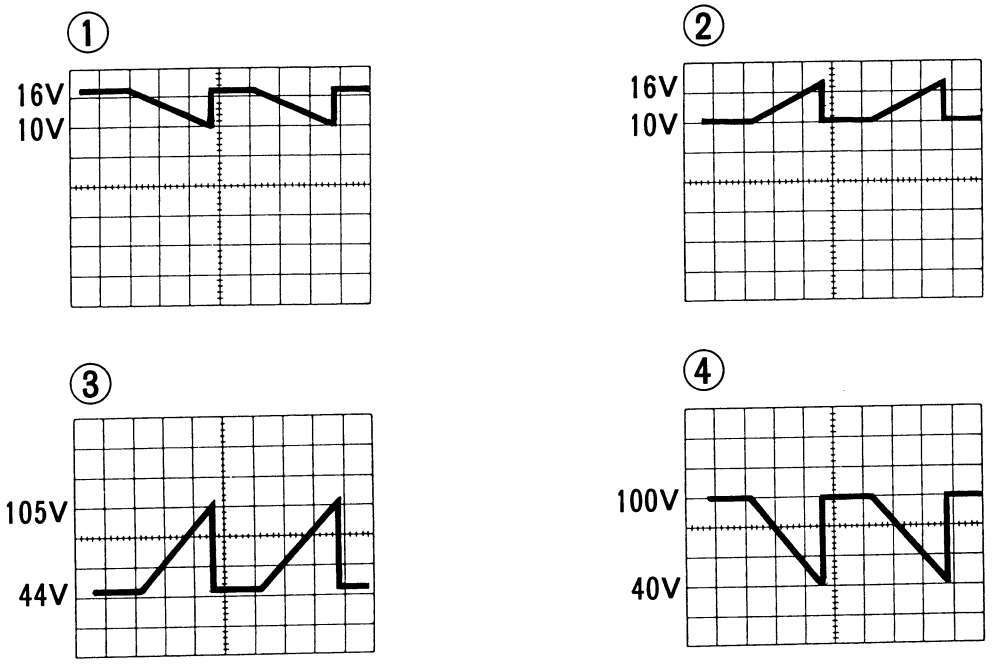
# OARD


D
E
VR2
VR1
7
P42
1
R11
P52
1
L1
L4
L3
L2
R15
R12
R8
D3
R3
D1
+
C4
D4
Q5
Q4
Q3
D2
R1
D6
+
C3
R13
R9
R6
R4
R2
+
C2
R16
D7
R14
D5
R10
Q2
R5
Q1
+
C1
D12
Q6
R7
+
R18
R17
C5

X74-1290-00
(HORIZONTAL OUTPUT AMP UNIT)

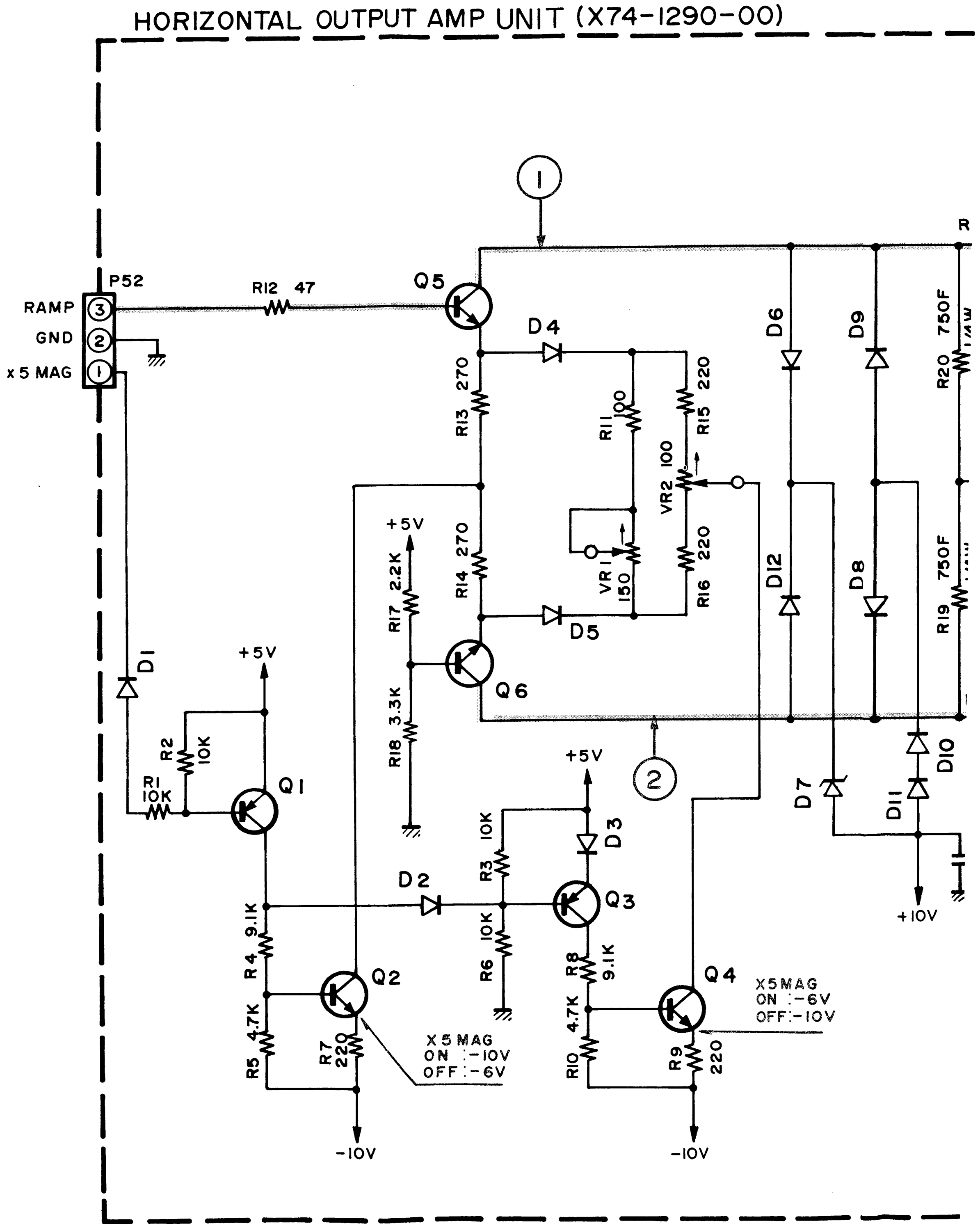


## WAVEFORM



**X74-1290-00**

## SCHEMATIC DIA

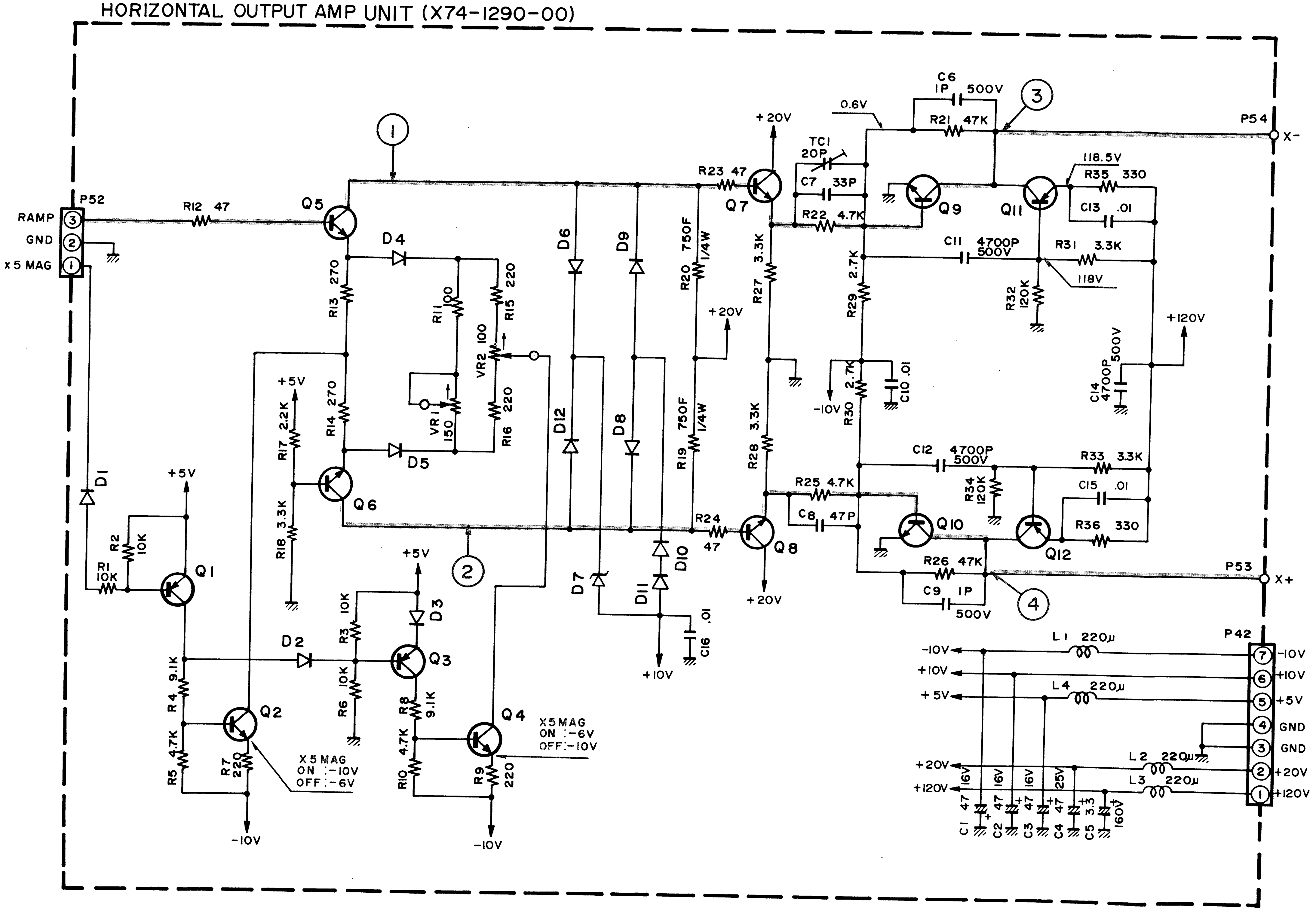

HORIZONTAL OUTPUT AMP UNIT (X74-1290-00)
P52
RAMP ③
GND ②
x 5 MAG ①
R12 47
Q5
D4
R13 270
R11 100
R15 220
VR2 100
R14 270
VR1 150
R16 220
D5
Q6
+5V
R17 2.2K
R18 3.3K
D1
+5V
R2 10K
R1 10K
Q1
D2
R3 10K
R6 10K
Q3
+5V
D3
R4 9.1K
R5 4.7K
Q2
R7 220
X5 MAG
ON :-10V
OFF:-6V
-10V
R8 9.1K
R10 4.7K
Q4
R9 220
X5MAG
ON :-6V
OFF:-10V
-10V
D6
D9
D12
D8
R20 750F
R19 750F
D7
D10
D11
+10V
R
①
②

Q1,3 : 2SA608KNP(F)
Q2,4 : 2SC536KNP(F)
Q5~8 : 2SC1973(T)
Q9,10 : 2SC805A-2(3)
Q11,12 : 2SA923-2(2,3)

D1~6, 8~12 : DS442X
D7 : WZ-071

# SCHEMATIC DIAGRAM

**X74-1290-00**

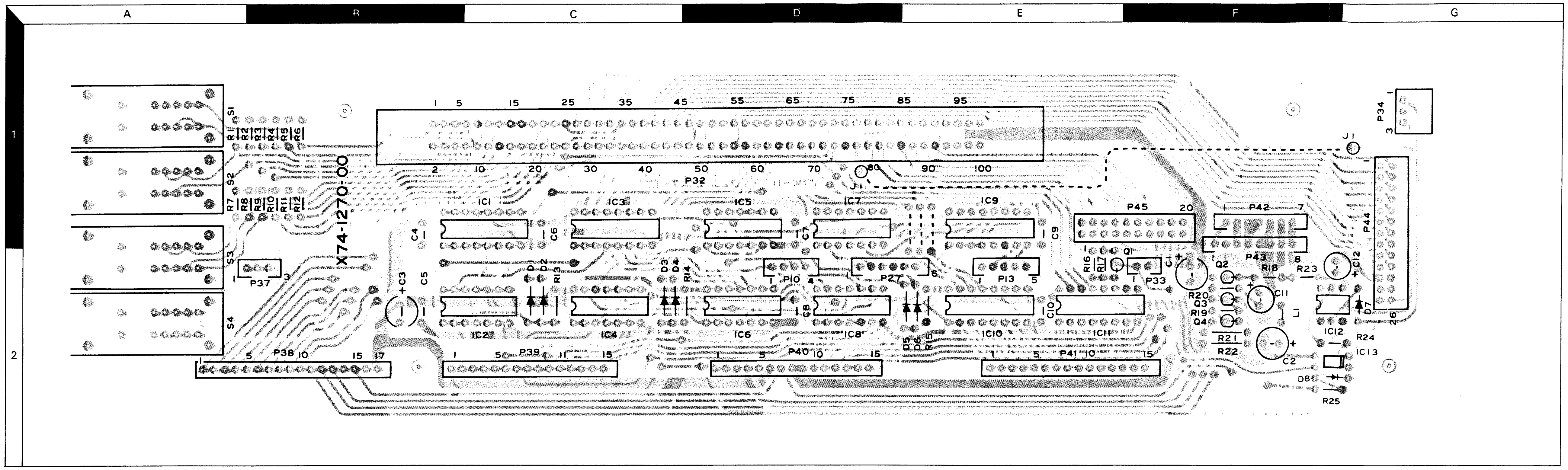

HORIZONTAL OUTPUT AMP UNIT (X74-1290-00)
P52
RAMP ③
GND ②
x5 MAG ①
R12 47
Q5
D4
R13 270
R11 100
R15 220
VR2 100
VR1 150
R14 270
R16 220
D5
Q6
R17 2.2K
R18 3.3K
+5V
D1
R2 10K
R1 10K
Q1
D2
R3 10K
R6 10K
D3
Q3
R4 9.1K
R5 4.7K
Q2
R7 220
X5 MAG
ON : -10V
OFF : -6V
R8 9.1K
R10 4.7K
Q4
R9 220
X5MAG
ON : -6V
OFF : -10V
-10V
①
②
D6
D9
D12
D8
D7
D10
D11
C16 .01
+10V
R20 750F 1/4W
R19 750F 1/4W
+20V
R23 47
Q7
R24 47
Q8
R27 3.3K
R28 3.3K
TC1 20P
C7 33P
R22 4.7K
R25 4.7K
C8 47P
0.6V
C6 1P 500V
R21 47K
③
Q9
Q11
118.5V
R35 330
C13 .01
C11 4700P 500V
R31 3.3K
118V
R32 120K
R29 2.7K
R30 2.7K
C10 .01
-10V
+120V
C14 4700P 500V
C12 4700P 500V
R33 3.3K
R34 120K
C15 .01
R36 330
Q10
Q12
R26 47K
C9 1P 500V
④
P54
X-
P53
X+
P42
L1 220μ
L4 220μ
L2 220μ
L3 220μ
⑦ -10V
⑥ +10V
⑤ +5V
④ GND
③ GND
② +20V
① +120V
C1 47 16V
C2 47 16V
C3 47 16V
C4 47 25V
C5 3.3 160V

Q1,3 : 2SA608KNP(F)
Q2,4 : 2SC536KNP(F)
Q5~8 : 2SC1973(T)
Q9,10 : 2SC805A-2(3)
Q11,12 : 2SA923-2(2,3)

D1~6, 8~12 : DS442X
D7 : WZ-071

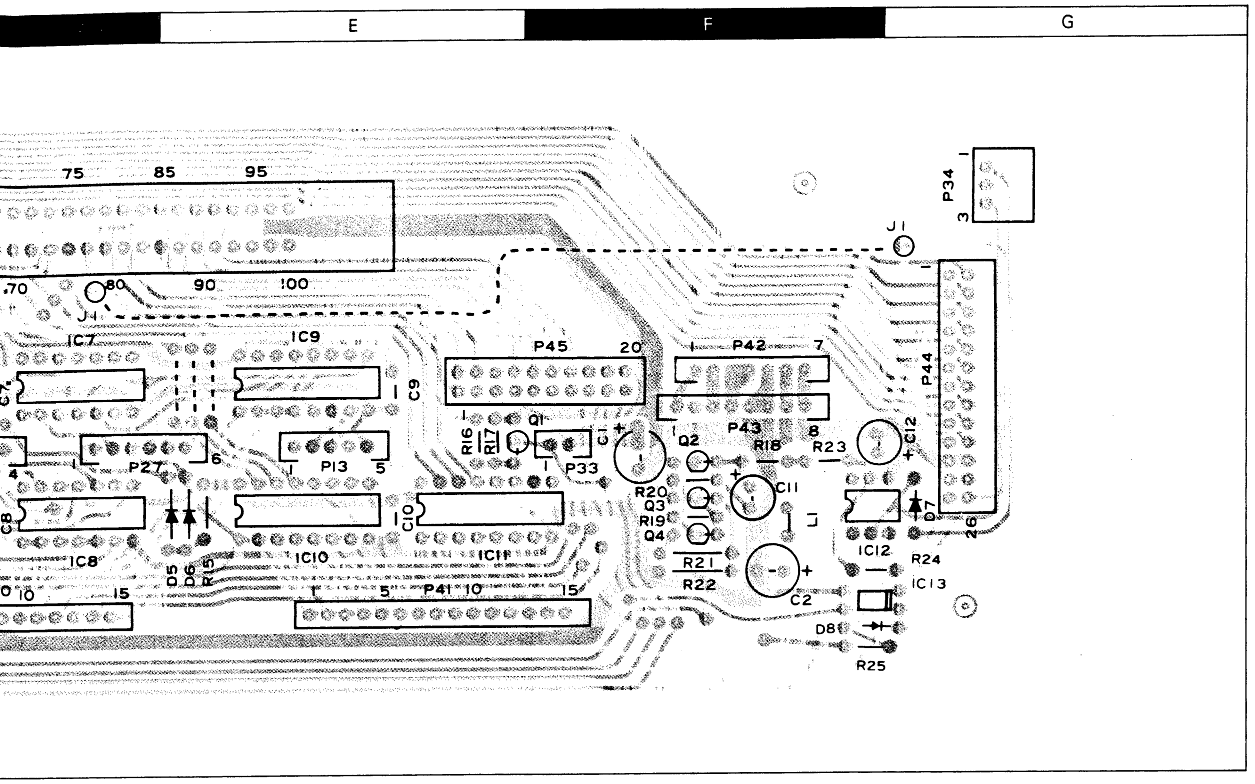
# P.C. BOARD

X74-1270-00

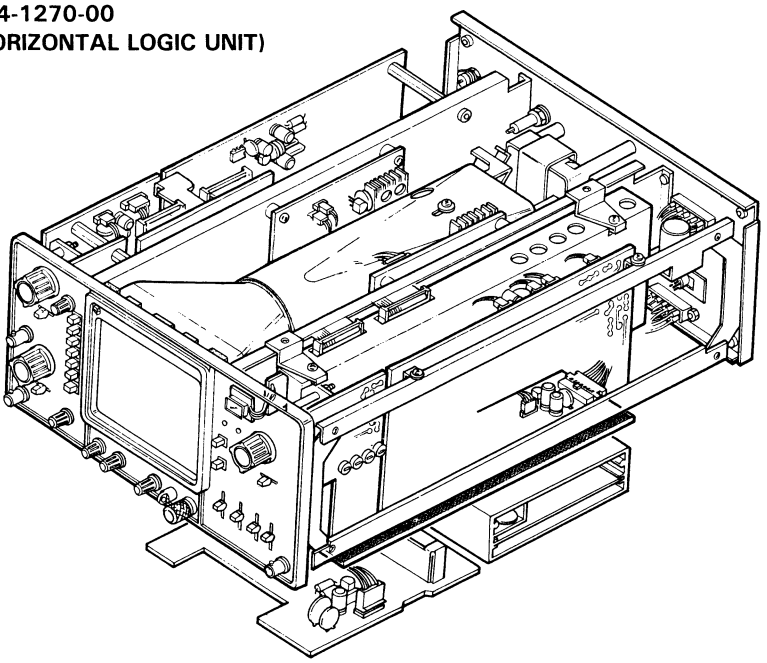

A
B
C
D
E
F
G
1
2
X74-1270-00
S1
S2
S3
S4
R1 R2 R3 R4 R5 R6
R7 R8 R9 R10 R11 R12
P37
P38
P39
P40
P41
P32
P10
P27
P13
P33
P34
P42
P43
P44
P45
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC12
IC13
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
D1 D2
D3 D4
D5 D6
D7
D8
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
Q1
Q2
Q3
Q4
L1
J1

X7
(HO

# BOARD


E
F
G
75
85
95
P34
1
3
J1
70
80
90
100
IC7
IC9
P45
20
P42
7
P44
C9
R16
R17
Q1
C1
Q2
P43
R18
8
R23
C12
P27
6
P13
5
P33
R20
Q3
R19
Q4
C11
L1
D7
IC12
R24
26
C8
IC8
D5
D6
R15
C10
IC10
IC11
P41
10
15
R21
R22
C2
IC13
D8
R25

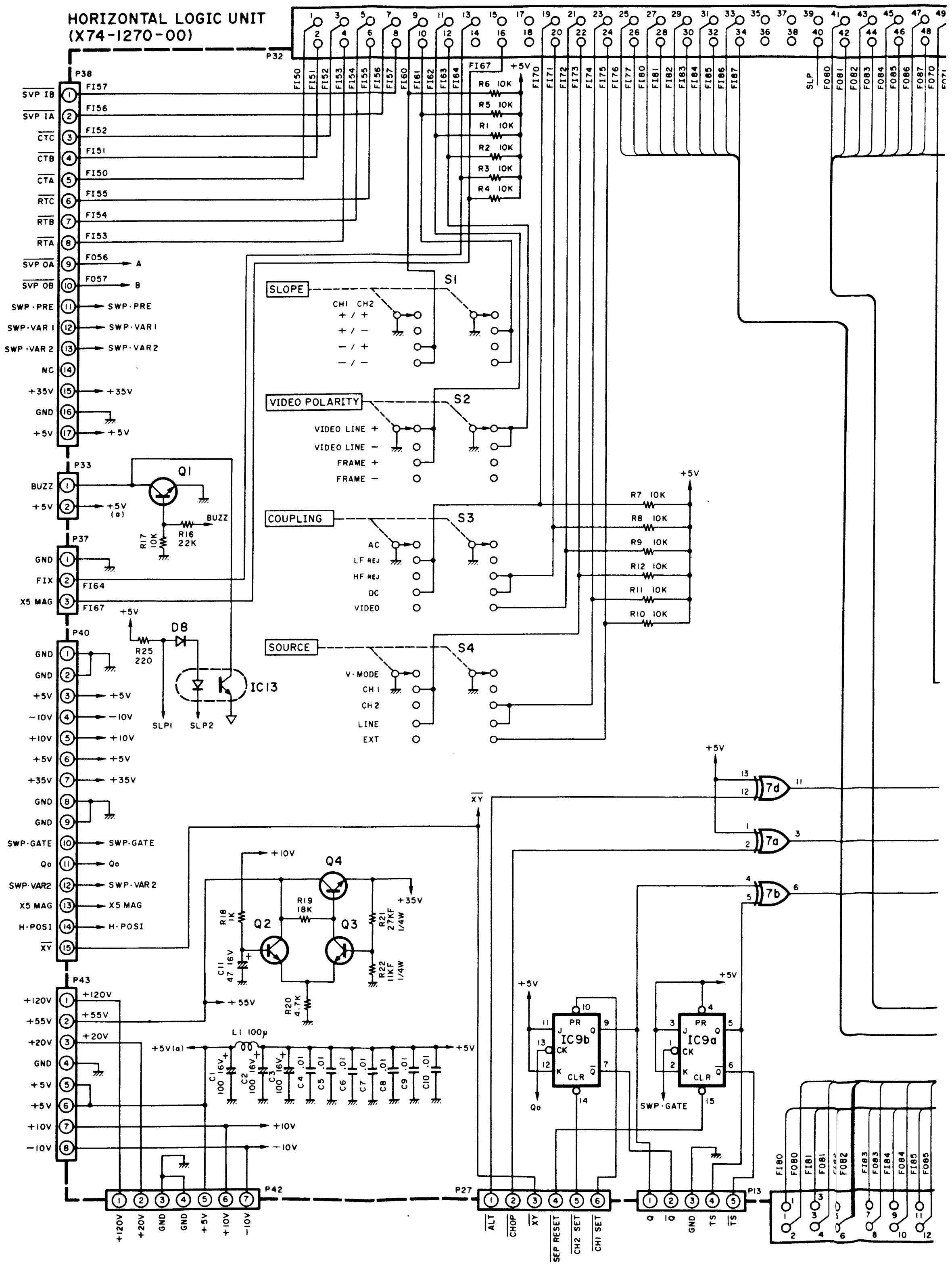
**X74-1270-00**
**(HORIZONTAL LOGIC UNIT)**



# WAVEFORM

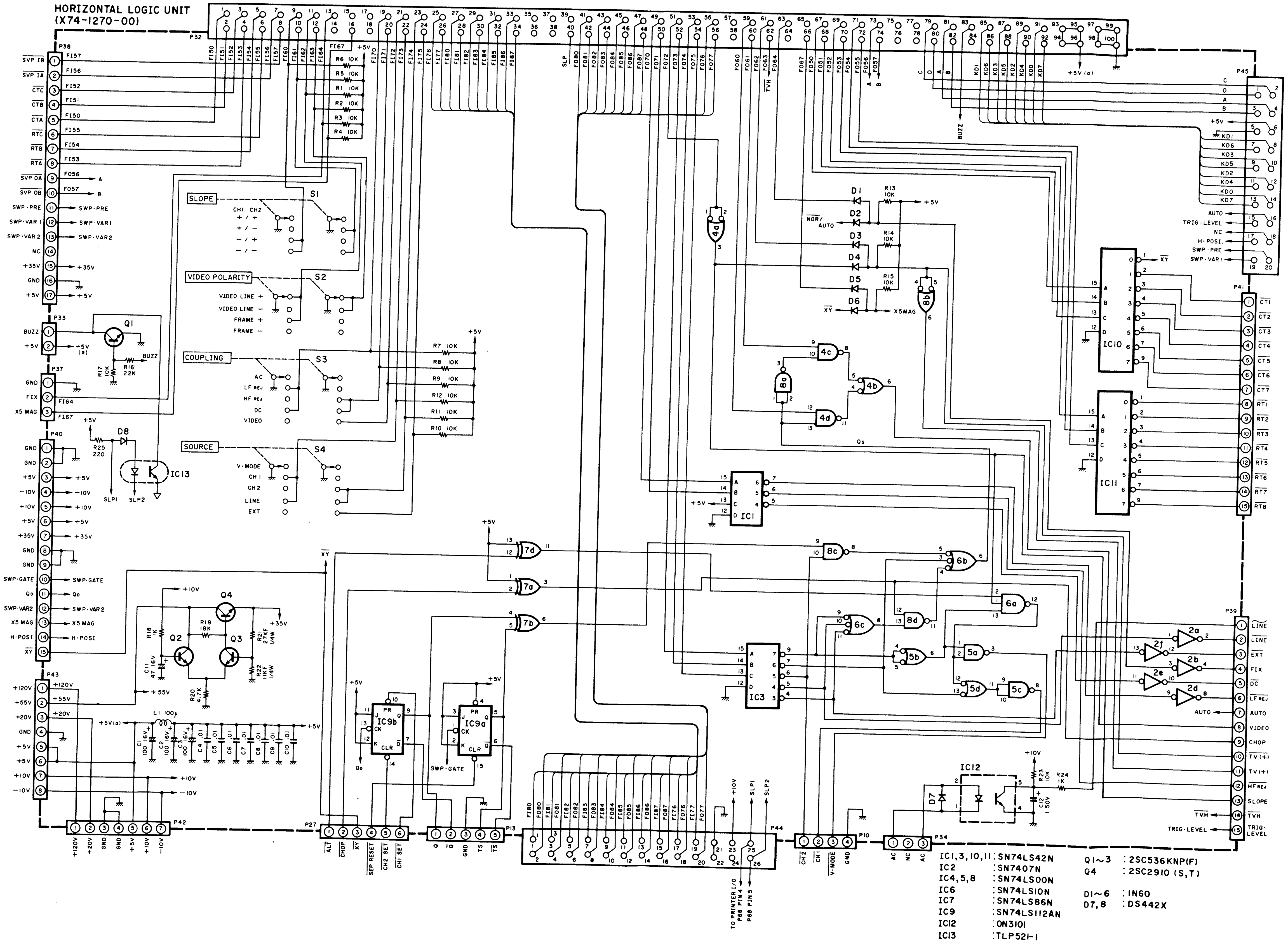
# SCHEMATIC I

X74-1270-00


HORIZONTAL LOGIC UNIT
(X74-1270-00)
P32
P38
SVP IB
SVP IA
CTC
CTB
CTA
RTC
RTB
RTA
SVP OA
SVP OB
SWP-PRE
SWP-VAR 1
SWP-VAR 2
NC
+35V
GND
+5V
P33
BUZZ
Q1
R16 22K
R17 10K
P37
FIX
X5 MAG
F164
F167
P40
D8
R25 220
IC13
SLP1
SLP2
-10V
+10V
SWP-GATE
Qo
H-POSI
XY
Q2
Q3
Q4
R18 1K
R19 18K
R20 4.7K
R21 27KF 1/4W
R22 11KF 1/4W
C11 47 16V
P43
+120V
+55V
+20V
L1 100μ
P42
SLOPE
S1
CH1 CH2
VIDEO POLARITY
S2
VIDEO LINE +
VIDEO LINE −
FRAME +
FRAME −
COUPLING
S3
AC
LF REJ
HF REJ
DC
VIDEO
SOURCE
S4
V-MODE
CH 1
CH 2
LINE
EXT
R1 10K
R2 10K
R3 10K
R4 10K
R5 10K
R6 10K
R7 10K
R8 10K
R9 10K
R10 10K
R11 10K
R12 10K
7d
7a
7b
IC9b
IC9a
PR
CLR
CK
P27
ALT
CHOP
SEP RESET
CH2 SET
CH1 SET
P13
TS
SLP

# SCHEMATIC DIAGRAM

**X74-1270-00**


HORIZONTAL LOGIC UNIT
(X74-1270-00)
P32
P38
SVP IB
SVP IA
CTC
CTB
CTA
RTC
RTB
RTA
SVP OA
SVP OB
SWP·PRE
SWP·VAR 1
SWP·VAR 2
NC
+35V
GND
+5V
P33
BUZZ
Q1
R16 22K
R17 10K
P37
FIX
X5 MAG
F164
F167
P40
D8
R25 220
IC13
SLP1
SLP2
SWP·GATE
Q0
H·POSI
XY
P43
+120V
+55V
+20V
+10V
−10V
Q2
Q3
Q4
R18 1K
R19 18K
R20 4.7K
R21 27KF 1/4W
R22 11KF 1/4W
C11 47 16V
L1 100μ
+5V(a)
C1 100 16V
C2 100 16V
C3 100 16V
C4 .01
C5 .01
C6 .01
C7 .01
C8 .01
C9 .01
C10 .01
P42
SLOPE
S1
CH1 CH2
VIDEO POLARITY
S2
VIDEO LINE +
VIDEO LINE −
FRAME +
FRAME −
COUPLING
S3
AC
LF REJ
HF REJ
DC
VIDEO
SOURCE
S4
V·MODE
CH 1
CH 2
LINE
EXT
R1 10K
R2 10K
R3 10K
R4 10K
R5 10K
R6 10K
R7 10K
R8 10K
R9 10K
R10 10K
R11 10K
R12 10K
IC9a
IC9b
PR
CLR
P27
ALT
CHOP
SEP RESET
CH2 SET
CH1 SET
P13
TS
P44
TO PRINTER I/O
P68 PIN 4
P68 PIN 5
P10
V·MODE
P34
NC
AC
IC1
IC3
IC10
IC11
IC12
D1
D2
D3
D4
D5
D6
D7
R13 10K
R14 10K
R15 10K
R23 10K
R24 1K
C12 1 50V
NOR/AUTO
X5MAG
Qs
P45
KD0
KD1
KD2
KD3
KD4
KD5
KD6
KD7
AUTO
TRIG·LEVEL
H·POSI
P41
CT1
CT2
CT3
CT4
CT5
CT6
CT7
RT1
RT2
RT3
RT4
RT5
RT6
RT7
RT8
P39
LINE
EXT
FIX
DC
LF REJ
VIDEO
CHOP
TV(+)
TV(−)
HF REJ
SLOPE
TVH
TRIG·LEVEL

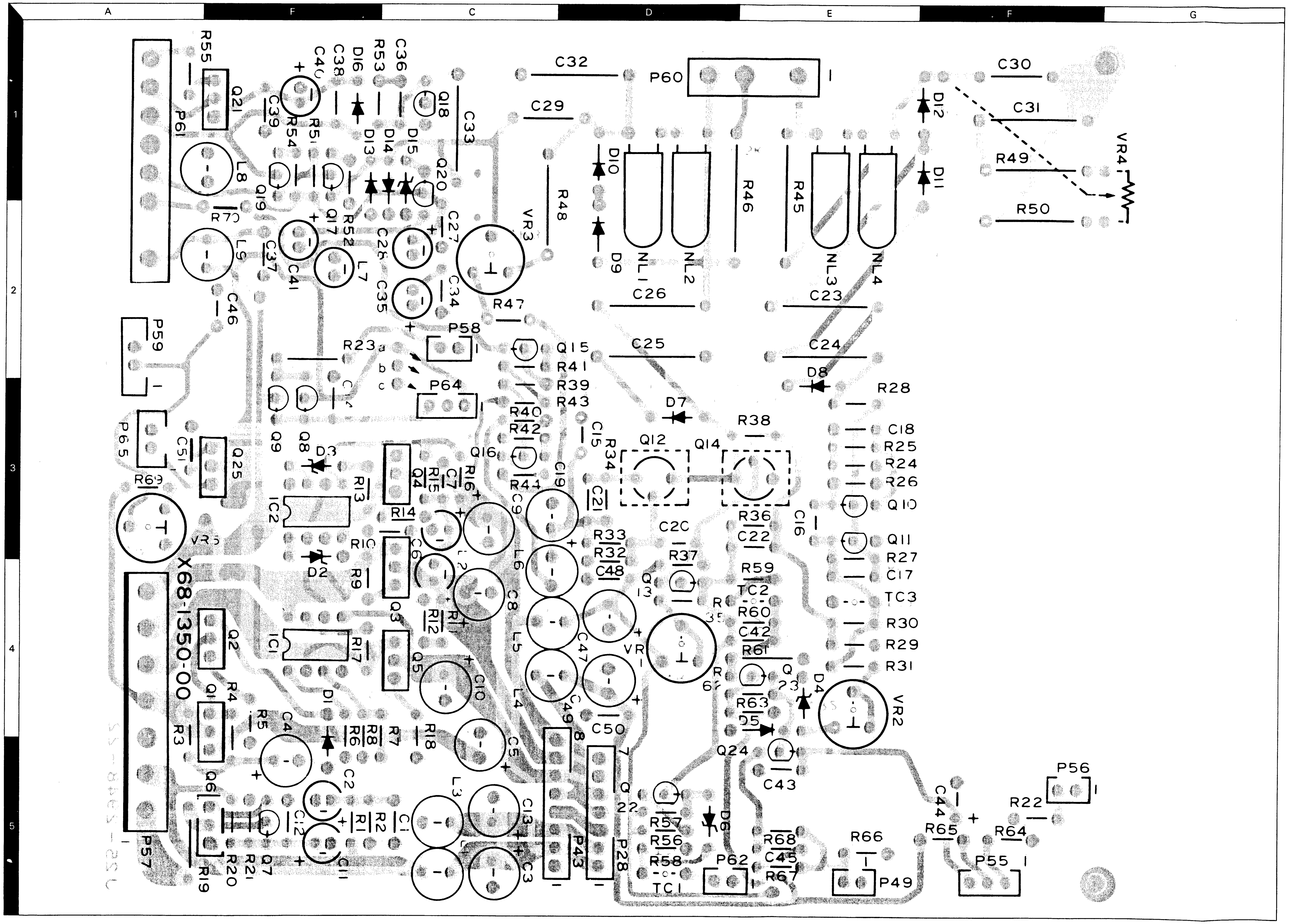
IC1,3,10,11 : SN74LS42N
IC2 : SN7407N
IC4,5,8 : SN74LS00N
IC6 : SN74LS10N
IC7 : SN74LS86N
IC9 : SN74LS112AN
IC12 : ON3101
IC13 : TLP521-1

Q1～3 : 2SC536KNP(F)
Q4 : 2SC2910 (S,T)

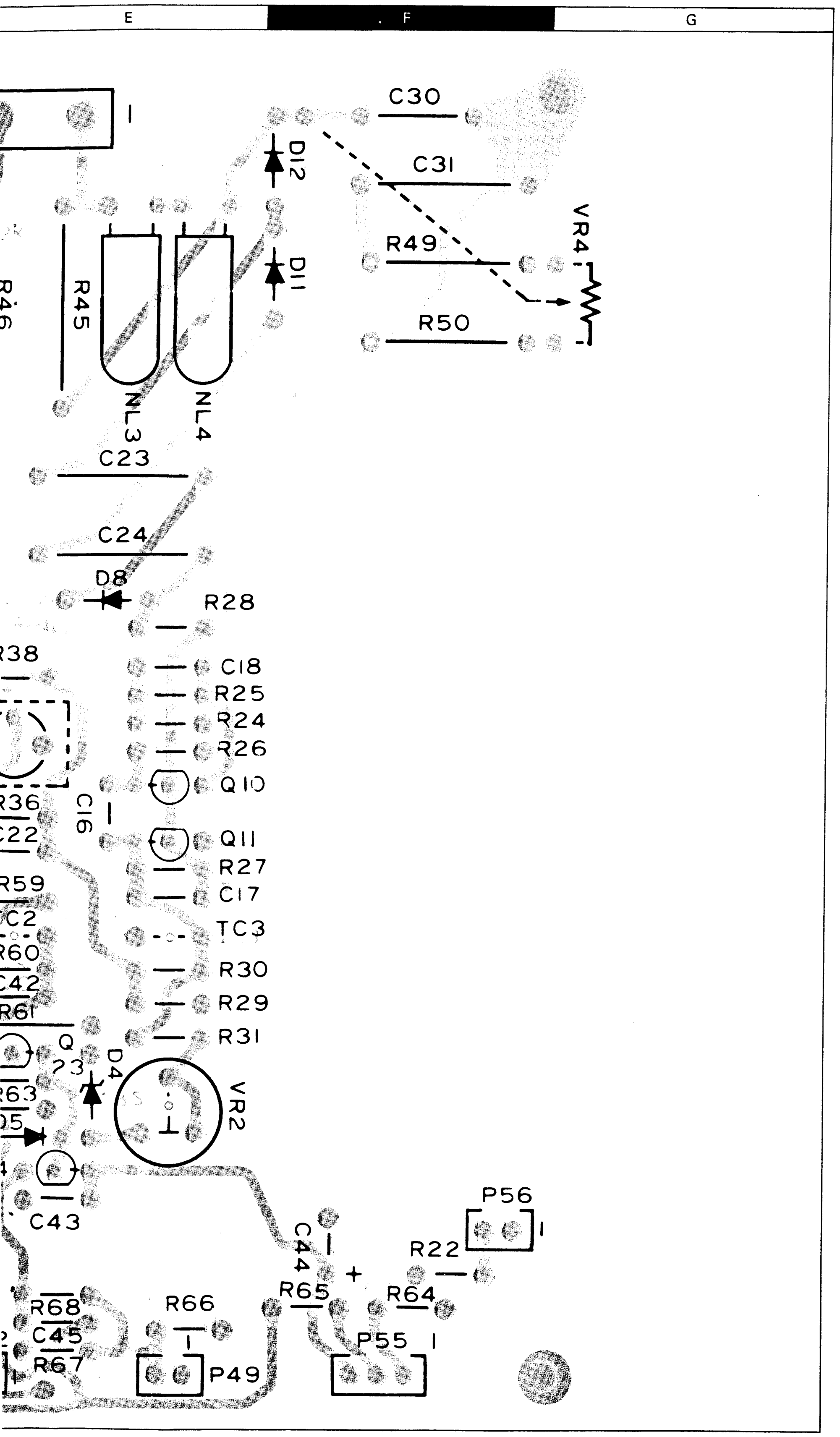
D1～6 : 1N60
D7,8 : DS442X

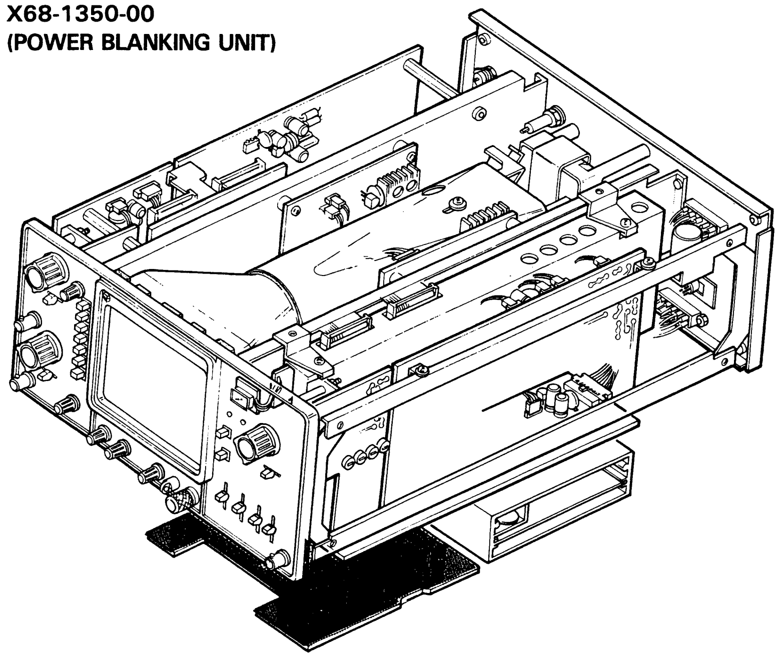
# P.C. BOARD

**X68-1350-00**


A
F
C
D
E
F
G
1
2
3
4
5
X68-1350-00
P60
P61
P59
P65
P58
P64
P57
P43
P28
P62
P49
P55
P56
C29
C30
C31
C32
C33
C34
C35
C36
C37
C38
C39
C40
C41
C46
C23
C24
C25
C26
C27
C28
C15
C16
C17
C18
C19
C20
C21
C22
C42
C43
C44
C45
C47
C48
C49
C50
C51
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
C14
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
R26
R27
R28
R29
R30
R31
R32
R33
R34
R35
R36
R37
R38
R39
R40
R41
R42
R43
R44
R45
R46
R47
R48
R49
R50
R51
R52
R53
R54
R55
R56
R57
R58
R59
R60
R61
R62
R63
R64
R65
R66
R67
R68
R69
R70
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q17
Q18
Q19
Q20
Q21
Q22
Q23
Q24
Q25
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
D16
IC1
IC2
L1
L2
L3
L4
L5
L6
L7
L8
L9
NL1
NL2
NL3
NL4
VR1
VR2
VR3
VR4
VR5
TC1
TC2
TC3
a
b
c

# ARD


E
F
G
C30
C31
D12
D11
VR4
R49
R50
R46
R45
NL3
NL4
C23
C24
D8
R28
R38
C18
R25
R24
R26
Q10
Q11
R36
C16
C22
R27
C17
R59
C2
TC3
R60
R30
C42
R29
R61
R31
Q23
D4
VR2
R63
D5
C43
P56
C44
R22
R65
R64
R68
R66
C45
P55
R67
P49

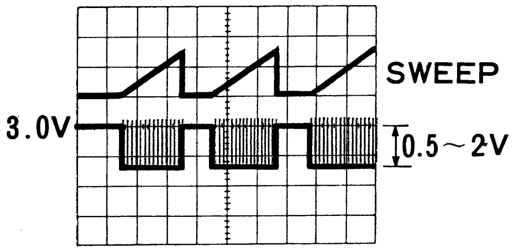


**X68-1350-00**
**(POWER BLANKING UNIT)**

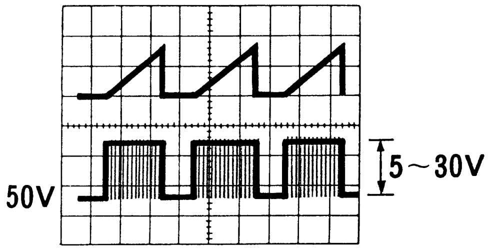
## WAVEFORM

NOTE: ▥ CHOP OPERATION

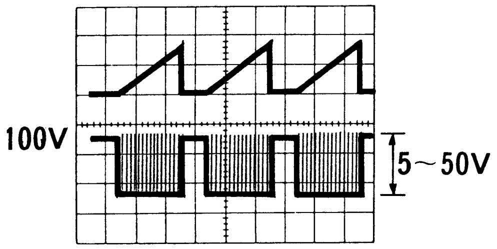
①



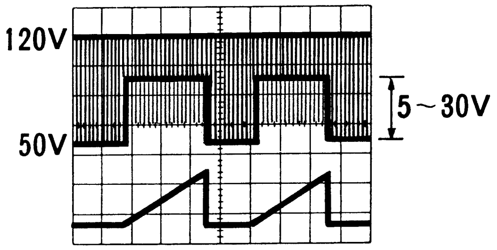
②



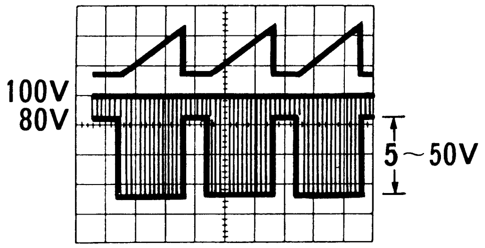
③



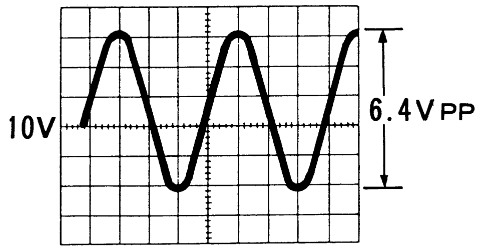
④



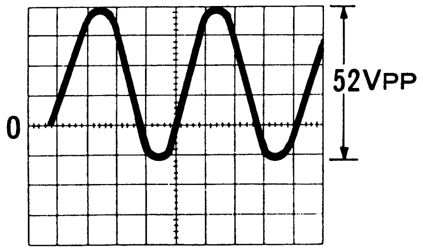
⑤



⑥

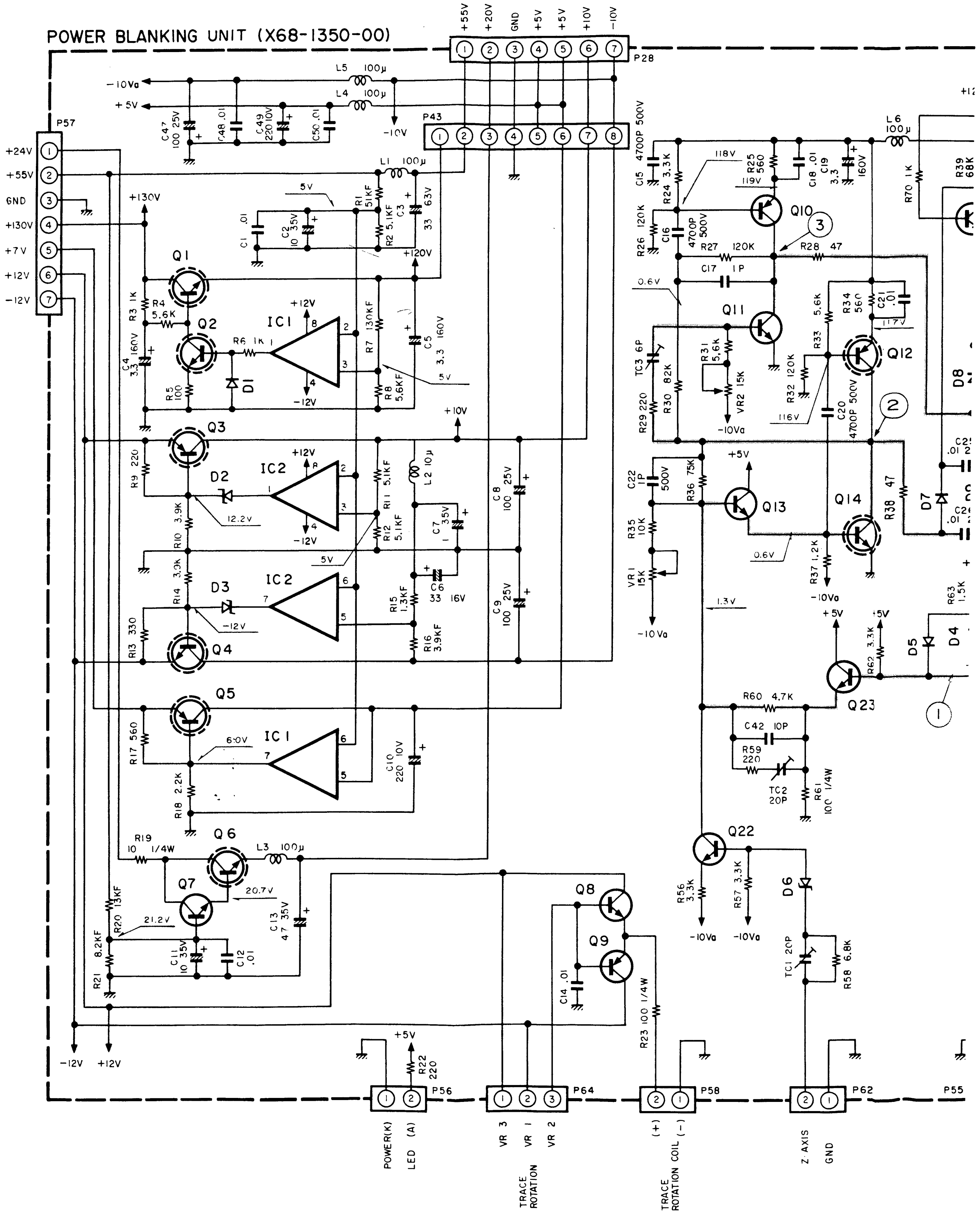


⑦



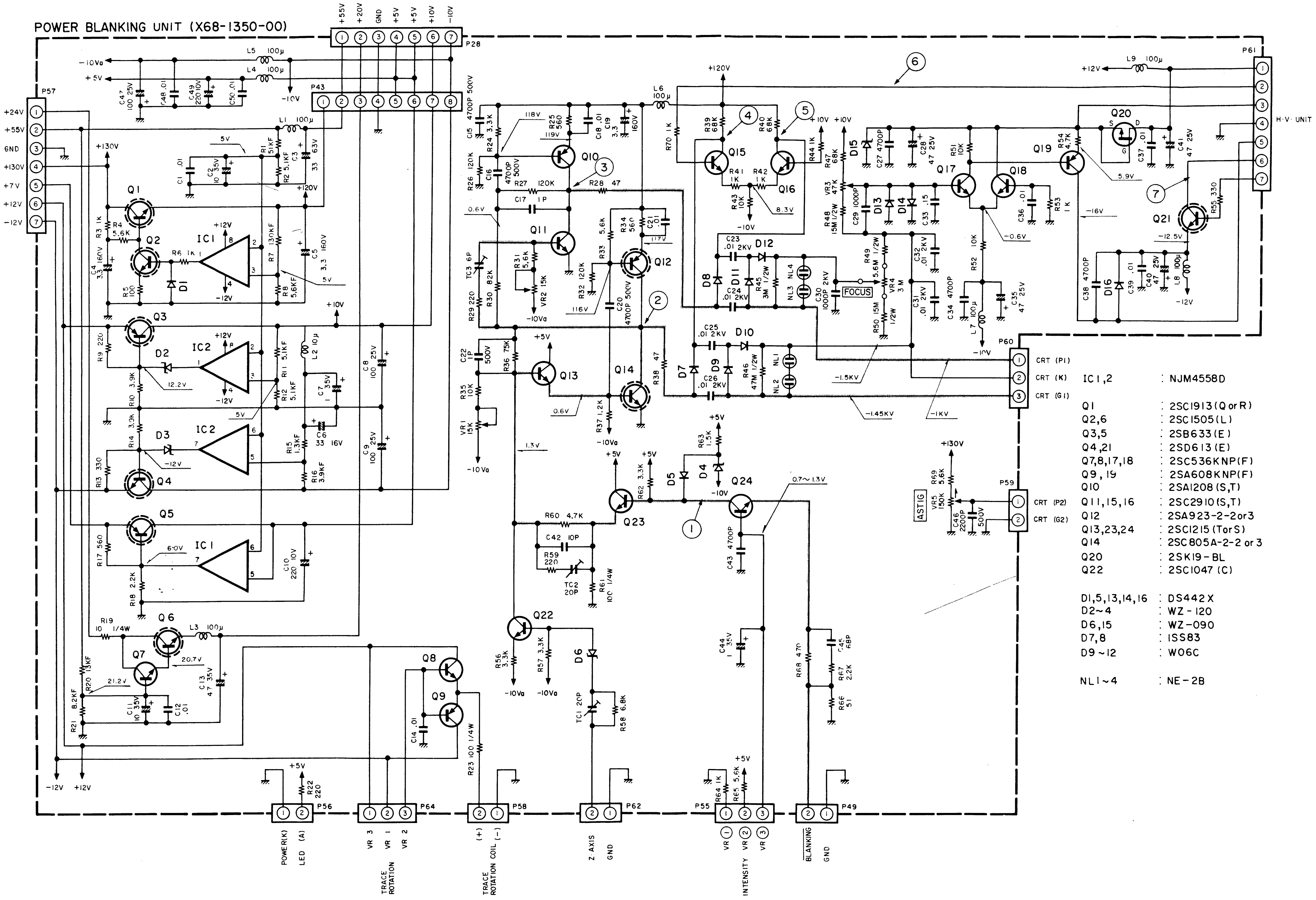
## SCHEMATIC DI

X68-1350-00


POWER BLANKING UNIT (X68-1350-00)
+55V
+20V
GND
+5V
+5V
+10V
-10V
P28
P43
P57
+24V
+55V
GND
+130V
+7V
+12V
-12V
-10Va
+5V
-10V
+130V
L1 100μ
L2 10μ
L3 100μ
L4 100μ
L5 100μ
L6 100μ
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q22
Q23
IC1
IC2
D1
D2
D3
D4
D5
D6
D7
D8
+120V
+12V
-12V
12.2V
6.0V
20.7V
21.2V
118V
119V
116V
117V
0.6V
1.3V
VR1 15K
VR2 15K
TC1 20P
TC2 20P
TC3 6P
R60 4.7K
C42 10P
R59 220
R61 100 1/4W
R56 3.3K
R57 3.3K
R58 6.8K
R23 100 1/4W
R22 220
C14 .01
P56
P64
P58
P62
P55
POWER(K)
LED (A)
VR 3
VR 1
VR 2
TRACE ROTATION
(+)
(-)
TRACE ROTATION COIL
Z AXIS
GND
①
②
③

# SCHEMATIC DIAGRAM

**X68-1350-00**


POWER BLANKING UNIT (X68-1350-00)
P28
+55V
+20V
GND
+5V
+5V
+10V
-10V
P43
P57
+24V
+55V
GND
+130V
+7V
+12V
-12V
P61
H·V· UNIT
+120V
+12V
FOCUS
ASTIG
P60
CRT (P1)
CRT (K)
CRT (G1)
P59
CRT (P2)
CRT (G2)
IC1
IC2
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q17
Q18
Q19
Q20
Q21
Q22
Q23
Q24
-1.5KV
-1.45KV
-1KV
P56
+5V
POWER(K)
LED (A)
P64
VR 3
VR 1
VR 2
TRACE ROTATION
P58
(+)
(-)
TRACE ROTATION COIL
P62
Z AXIS
GND
P55
VR ①
VR ②
VR ③
INTENSITY
P49
BLANKING
GND
-12V
+12V

IC1,2 : NJM4558D

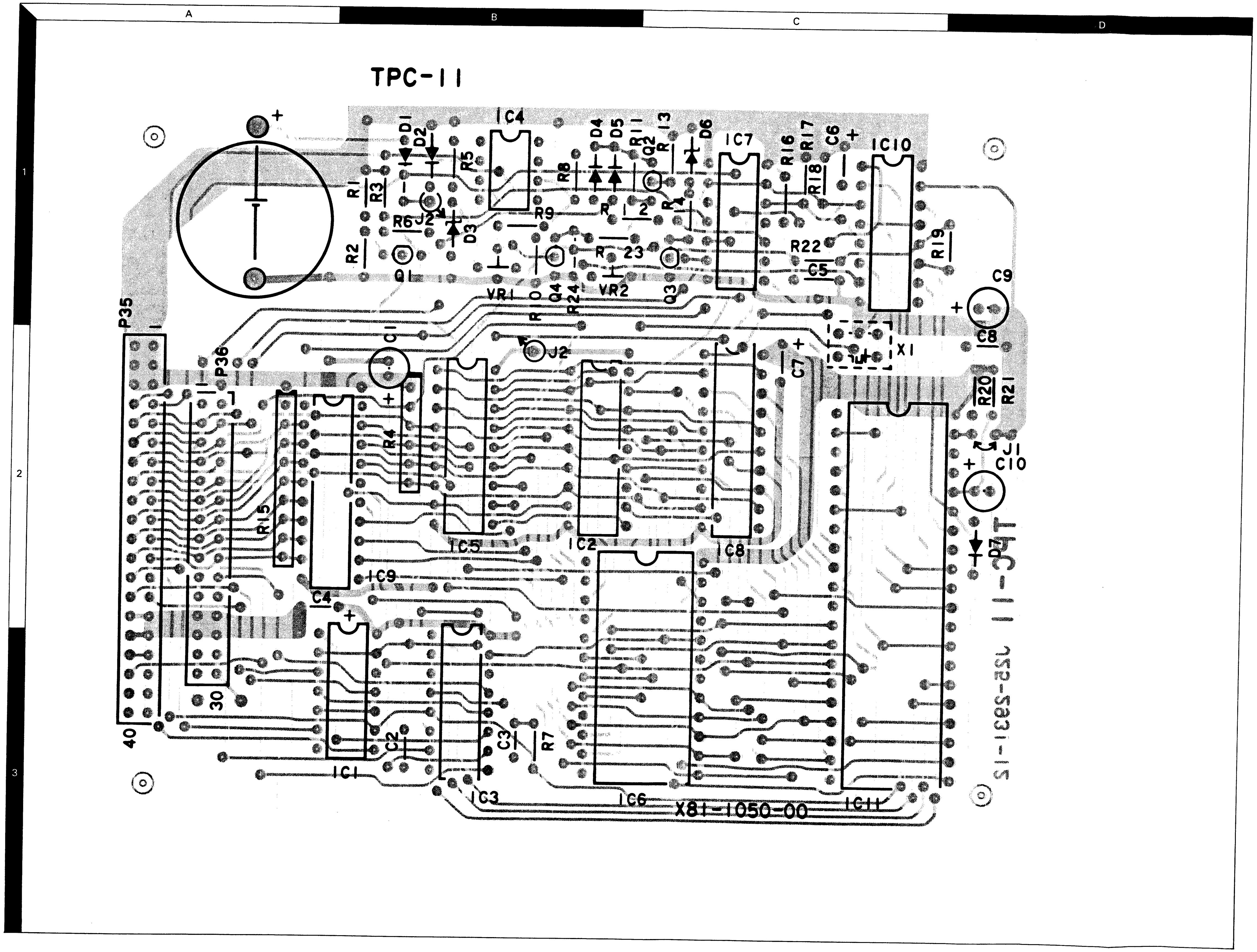
Q1 : 2SC1913(Q or R)
Q2,6 : 2SC1505(L)
Q3,5 : 2SB633(E)
Q4,21 : 2SD613(E)
Q7,8,17,18 : 2SC536KNP(F)
Q9,19 : 2SA608KNP(F)
Q10 : 2SA1208(S,T)
Q11,15,16 : 2SC2910(S,T)
Q12 : 2SA923-2-2or3
Q13,23,24 : 2SC1215 (Tor S)
Q14 : 2SC805A-2-2 or 3
Q20 : 2SK19-BL
Q22 : 2SC1047 (C)

D1,5,13,14,16 : DS442X
D2~4 : WZ-120
D6,15 : WZ-090
D7,8 : 1SS83
D9~12 : W06C

NL1~4 : NE-2B

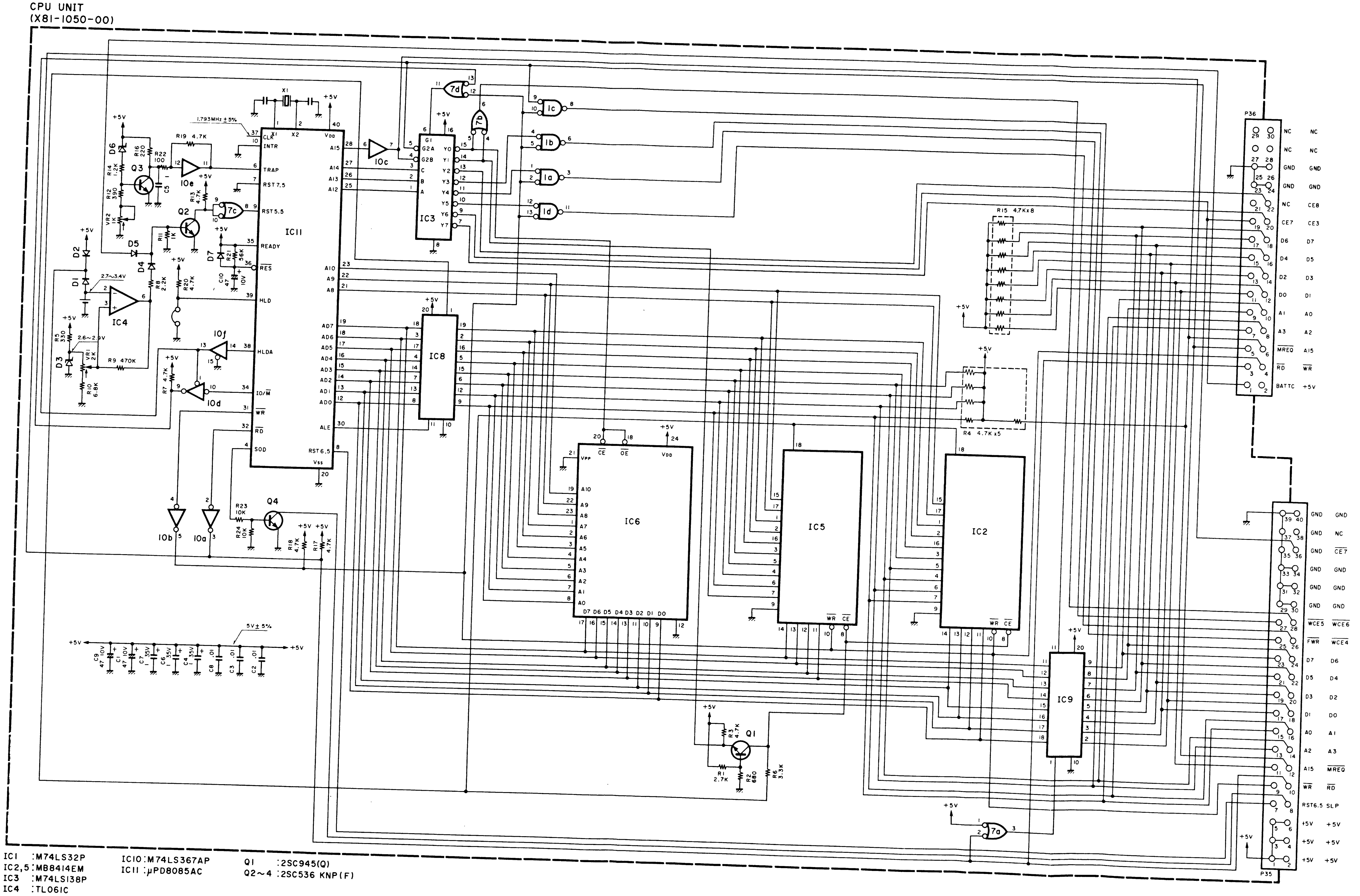
# P.C. BOARD

X81-1050-00


A
B
C
D
1
2
3
TPC-11
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
D1
D2
D3
D4
D5
D6
D7
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
Q1
Q2
Q3
Q4
VR1
VR2
J1
J2
X1
P35
P36
30
40
X81-1050-00
TPC-11
JSZ-2831-15

# SCHEMATIC DIAGRAM

## X81-1050-00


CPU UNIT
(X81-1050-00)
IC11
X1
1.793MHz ± 5%
CLK
INTR
TRAP
RST7.5
RST5.5
READY
RES
HLD
HLDA
IO/M
WR
RD
SOD
RST6.5
VDD
VSS
A15
A14
A13
A12
A10
A9
A8
AD7
AD6
AD5
AD4
AD3
AD2
AD1
AD0
ALE
IC3
G1
G2A
G2B
Y0
Y1
Y2
Y3
Y4
Y5
Y6
Y7
IC4
2.7~3.4V
2.6~2.9V
IC8
IC6
VPP
CE
OE
IC5
IC2
IC9
WR
CE
10a
10b
10c
10d
10e
10f
7a
7b
7c
7d
1a
1b
1c
1d
Q1
Q2
Q3
Q4
D1
D2
D3
D4
D5
D6
D7
R1 2.7K
R2 680
R3 4.7K
R4 4.7K×5
R5 330
R6 3.3K
R7 4.7K
R8 2.2K
R9 470K
R10 6.8K
R11 1K
R12 390
R13 4.7K
R14 1.2K
R15 4.7K×8
R16 220
R17 4.7K
R18 4.7K
R19 4.7K
R20 4.7K
R21 56K
R22 100
R23 10K
R24 10K
VR1 2K
VR2 1K
C1 47 10V
C2 .01
C3 .01
C4 1 35V
C5
C6 1 35V
C7 1 35V
C8 .01
C9 47 10V
C10 47 10V
5V ± 5%
+5V
P36
NC NC
NC NC
GND GND
GND GND
NC CE8
CE7 CE3
D6 D7
D4 D5
D2 D3
D0 D1
A1 A0
A3 A2
MREQ A15
RD WR
BATTC +5V
P35
GND GND
GND NC
GND CE7
GND GND
GND GND
GND GND
WCE5 WCE6
FWR WCE4
D7 D6
D5 D4
D3 D2
D1 D0
A0 A1
A2 A3
A15 MREQ
WR RD
RST6.5 SLP
+5V +5V
+5V +5V
+5V +5V

IC1 :M74LS32P
IC2,5 :MB8414EM
IC3 :M74LS138P
IC4 :TL061C
IC6 :MB8516EC
IC7 :M74LS00P
IC8 :M74LS373P
IC9 :MB74LS245M

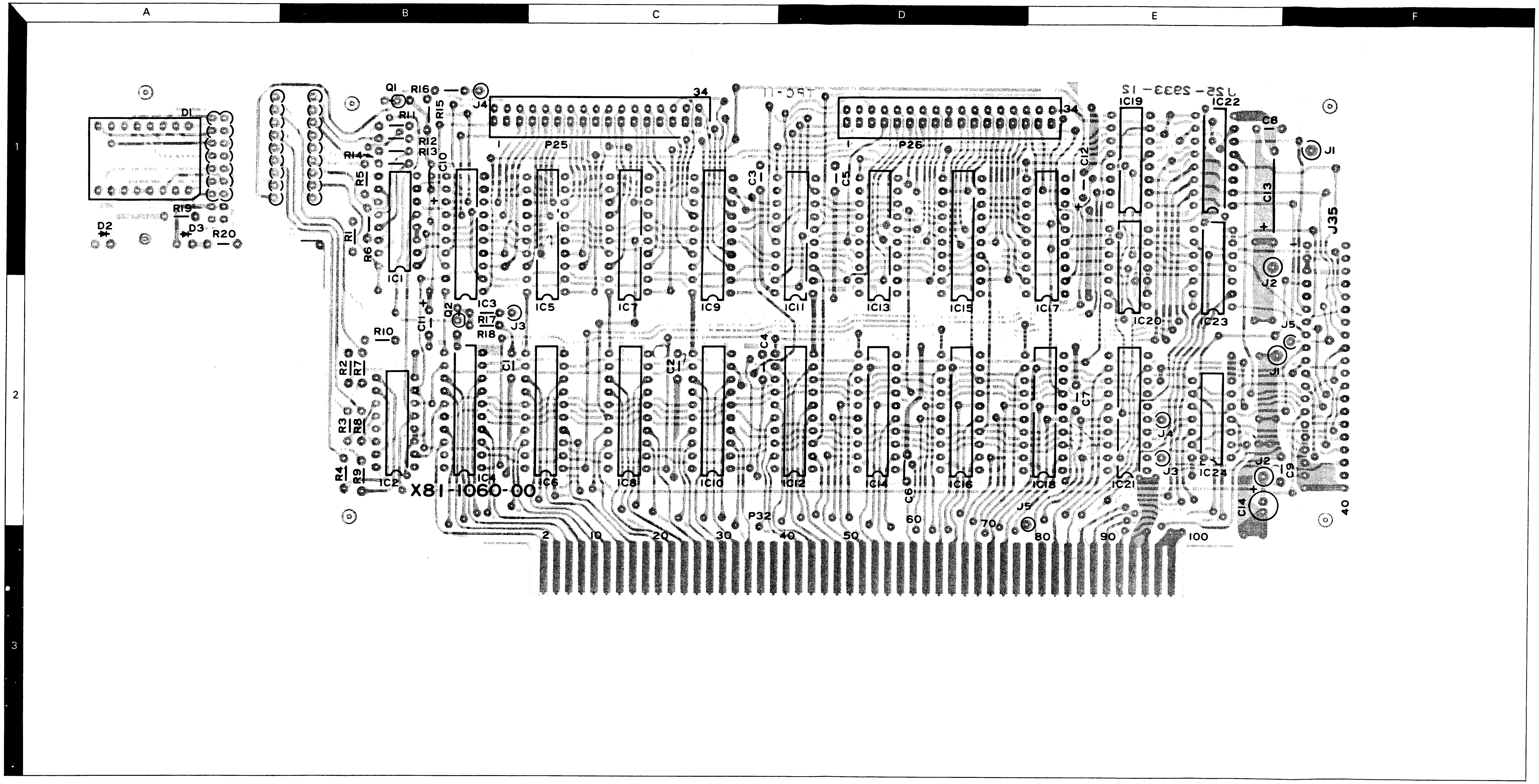
IC10 :M74LS367AP
IC11 :μPD8085AC

Q1 :2SC945(Q)
Q2~4 :2SC536 KNP(F)

D1,2 :1S1544A
D3,6 :WZ-032
D4,5,7 :DS442X

# P.C. BOARD

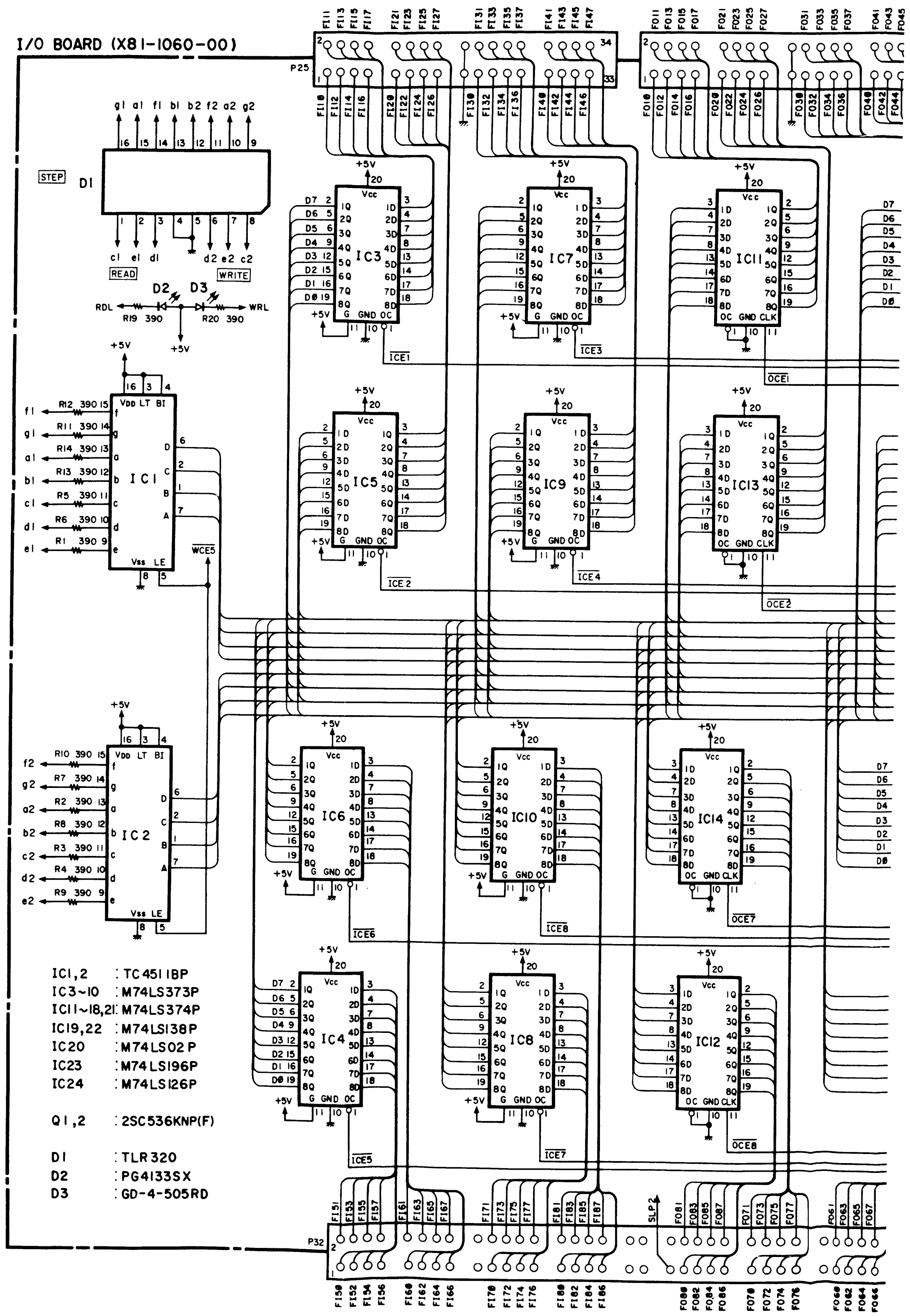
X81-1060-00


A
B
C
D
E
F
1
2
3
D1
D2
D3
Q1
Q2
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
C14
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC12
IC13
IC14
IC15
IC16
IC17
IC18
IC19
IC20
IC21
IC22
IC23
IC24
J1
J2
J3
J4
J5
J35
P25
P26
P32
1
34
2
10
20
30
40
50
60
70
80
90
100
X81-1060-00
J25-2933-12

# WAVEFORM

# SCHEMATIC I

## X81-1060-00


I/O BOARD (X81-1060-00)
P25
P32
STEP
READ
WRITE
D1
D2
D3
RDL
WRL
R19 390
R20 390
+5V
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC12
IC13
IC14
ICE1
ICE2
ICE3
ICE4
ICE5
ICE6
ICE7
ICE8
OCE1
OCE2
OCE7
OCE8
WCE5
SLP2

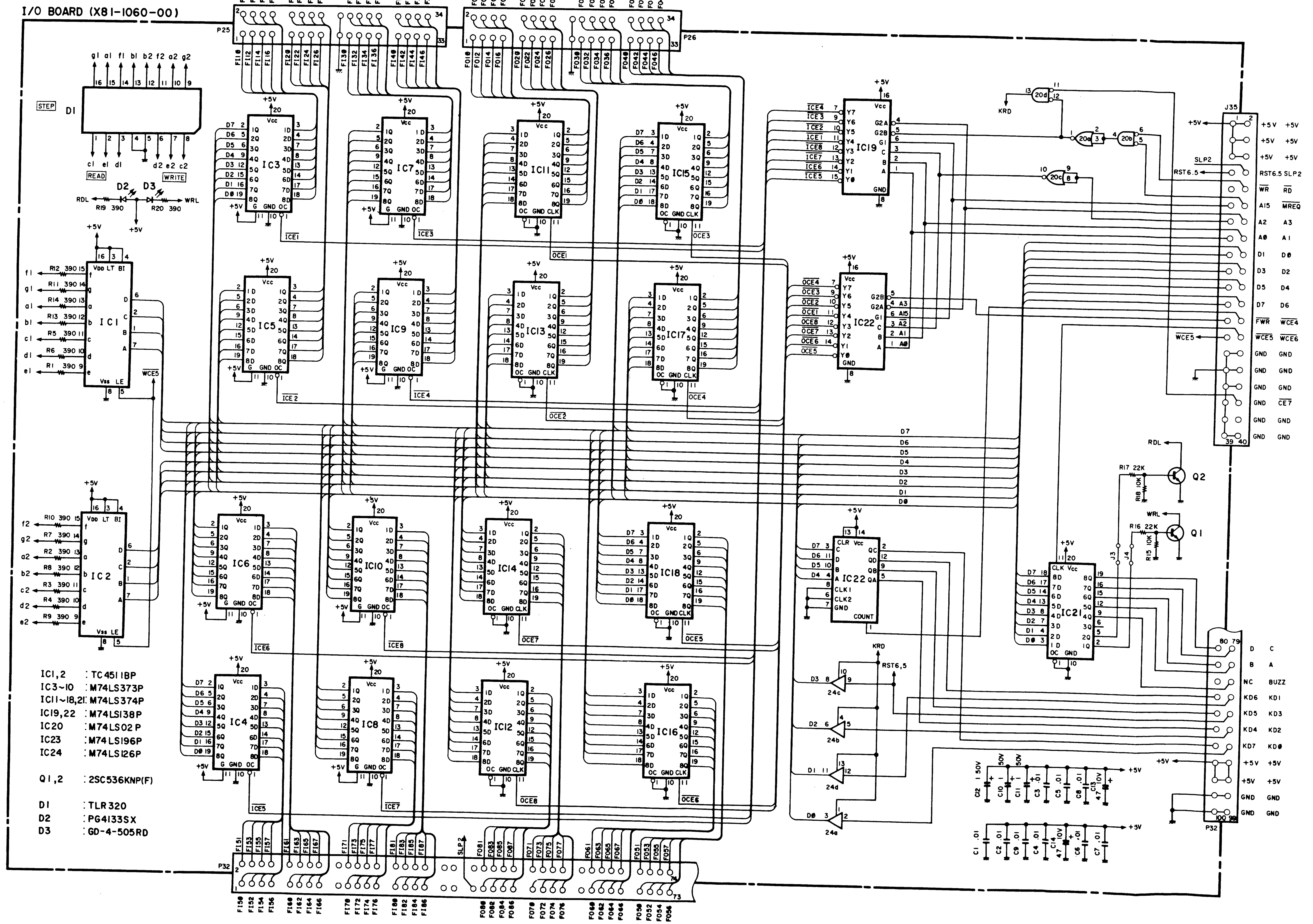
IC1,2 : TC4511BP
IC3~10 : M74LS373P
IC11~18,21 : M74LS374P
IC19,22 : M74LS138P
IC20 : M74LS02 P
IC23 : M74LS196P
IC24 : M74LS126P

Q1,2 : 2SC536KNP(F)

D1 : TLR320
D2 : PG4133SX
D3 : GD-4-505RD

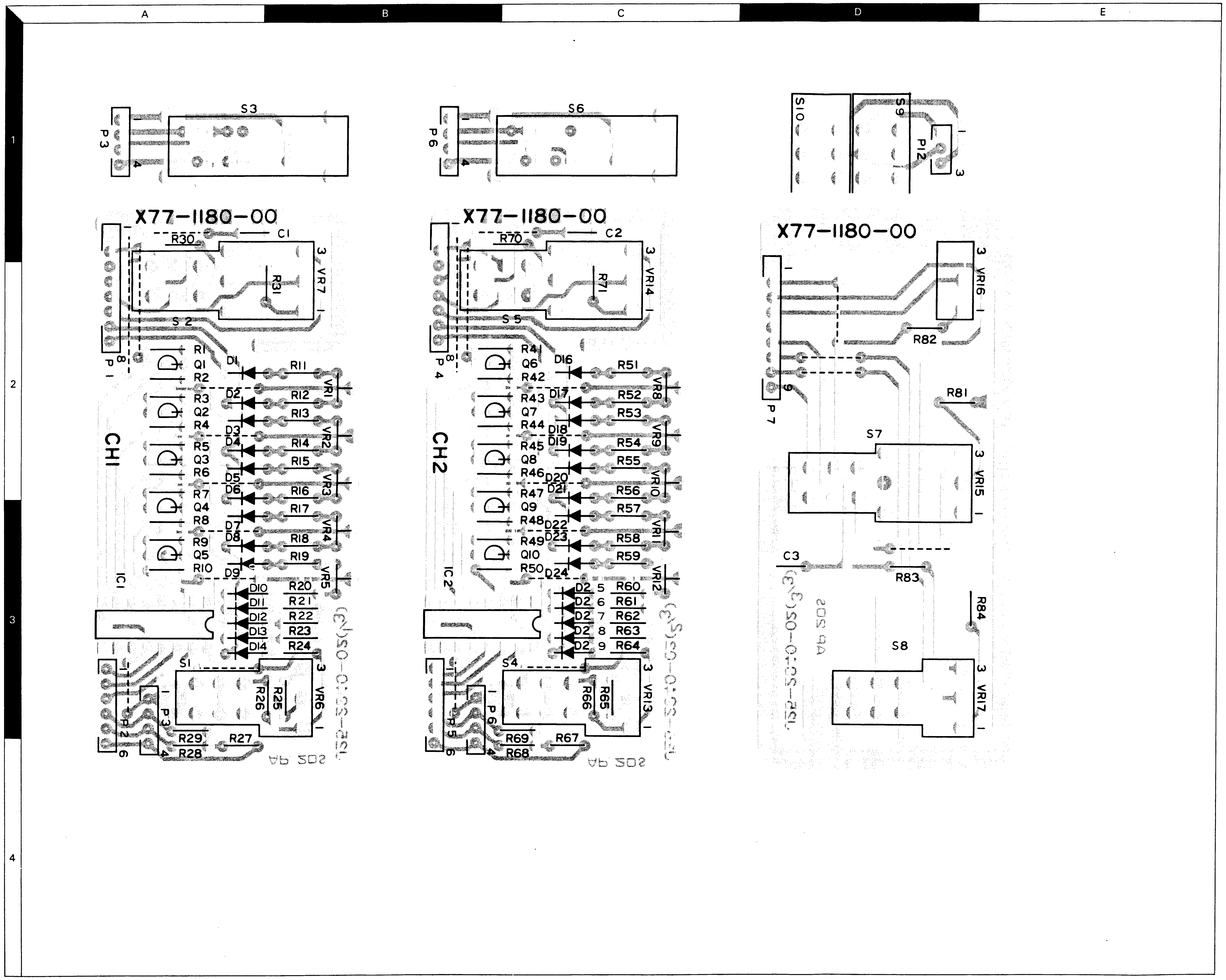
# SCHEMATIC DIAGRAM

**X81-1060-00**


I/O BOARD (X81-1060-00)
P25
P26
P32
J35
STEP
READ
WRITE
D1
D2
D3
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC12
IC13
IC14
IC15
IC16
IC17
IC18
IC19
IC21
IC22
Q1
Q2
RDL
WRL
KRD
RST6.5
SLP2
IC1,2 : TC4511BP
IC3~10 : M74LS373P
IC11~18,21 : M74LS374P
IC19,22 : M74LS138P
IC20 : M74LS02P
IC23 : M74LS196P
IC24 : M74LS126P
Q1,2 : 2SC536KNP(F)
D1 : TLR320
D2 : PG4133SX
D3 : GD-4-505RD

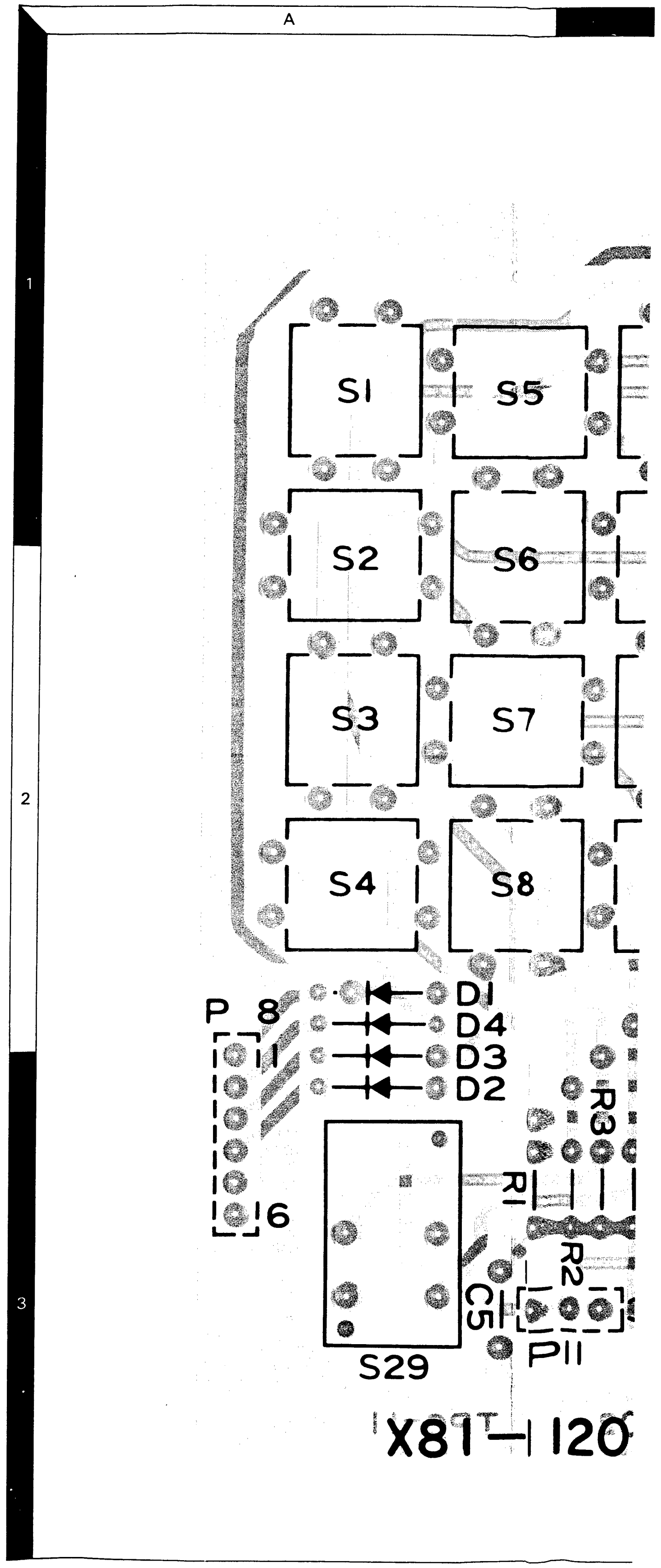
# P.C. BOARD

RT-1721 X77-1180-00



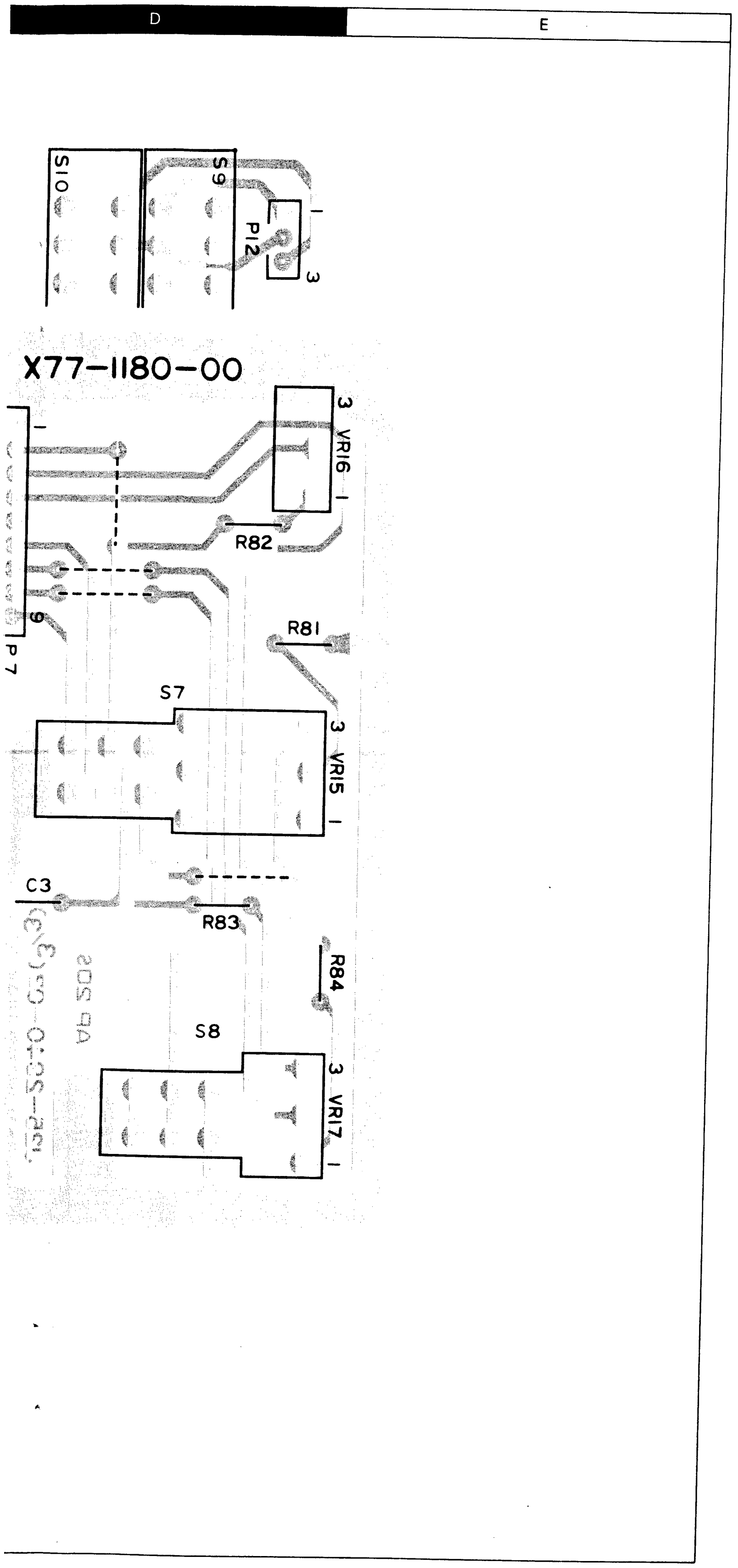
A
B
C
D
E
1
2
3
4
X77-1180-00
X77-1180-00
X77-1180-00
CH1
CH2
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
P1
P2
P3
P4
P5
P6
P7
P12
IC1
IC2
C1
C2
C3
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D16
D17
D18
D19
D20
D21
D22
D23
D24
D25
D26
D27
D28
D29
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
R26
R27
R28
R29
R30
R31
R41
R42
R43
R44
R45
R46
R47
R48
R49
R50
R51
R52
R53
R54
R55
R56
R57
R58
R59
R60
R61
R62
R63
R64
R65
R66
R67
R68
R69
R70
R71
R81
R82
R83
R84
VR1
VR2
VR3
VR4
VR5
VR6
VR7
VR8
VR9
VR10
VR11
VR12
VR13
VR14
VR15
VR16
VR17

X81-1120-00

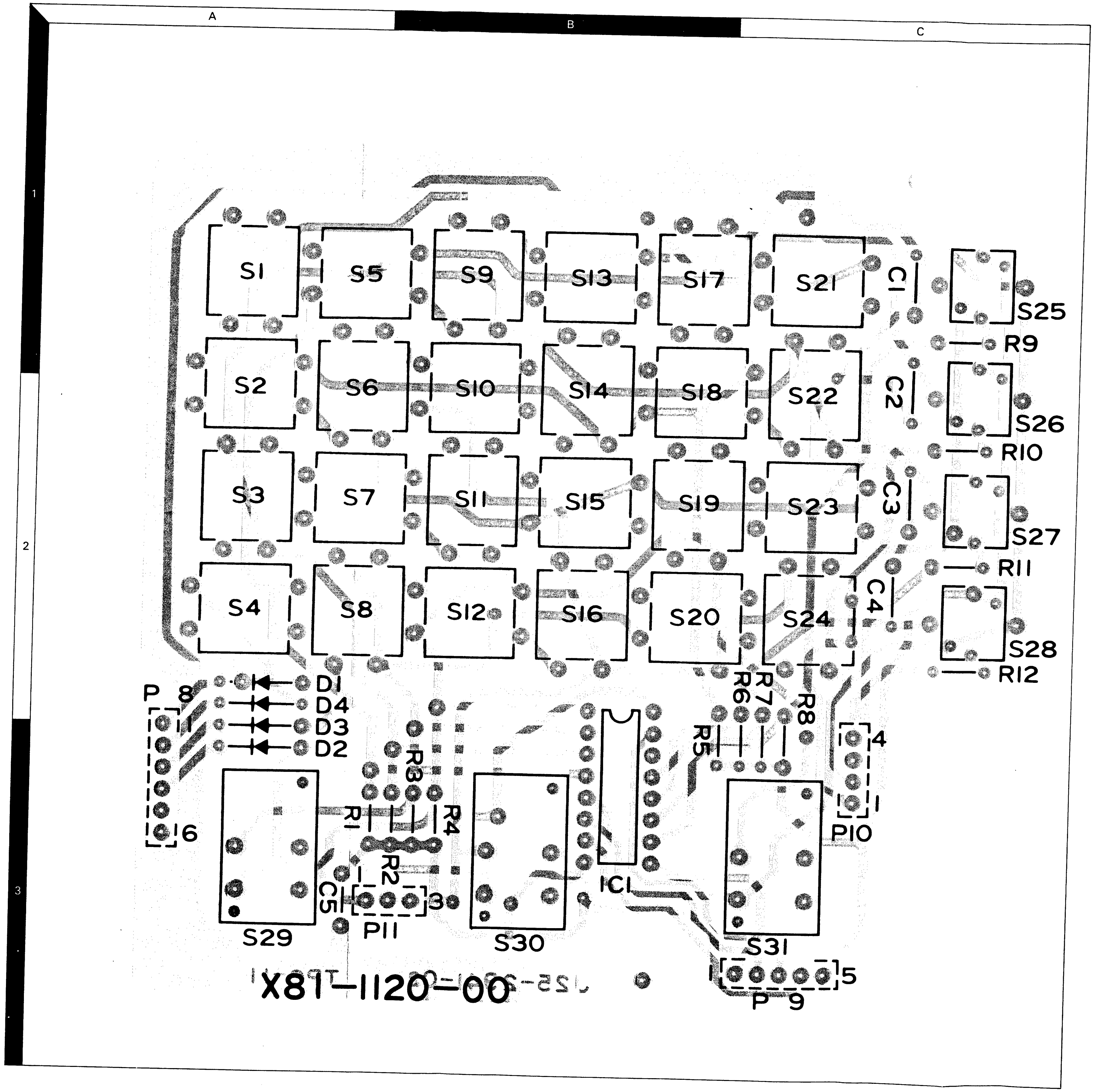


A
1
2
3
S1
S2
S3
S4
S5
S6
S7
S8
S29
P8
P11
D1
D2
D3
D4
R1
R2
R3
C5
6
X81-1120

## P.C. BOARD


D
E
S10
S9
P12
X77-1180-00
VR16
R82
R81
P7
S7
VR15
C3
R83
R84
S8
VR17

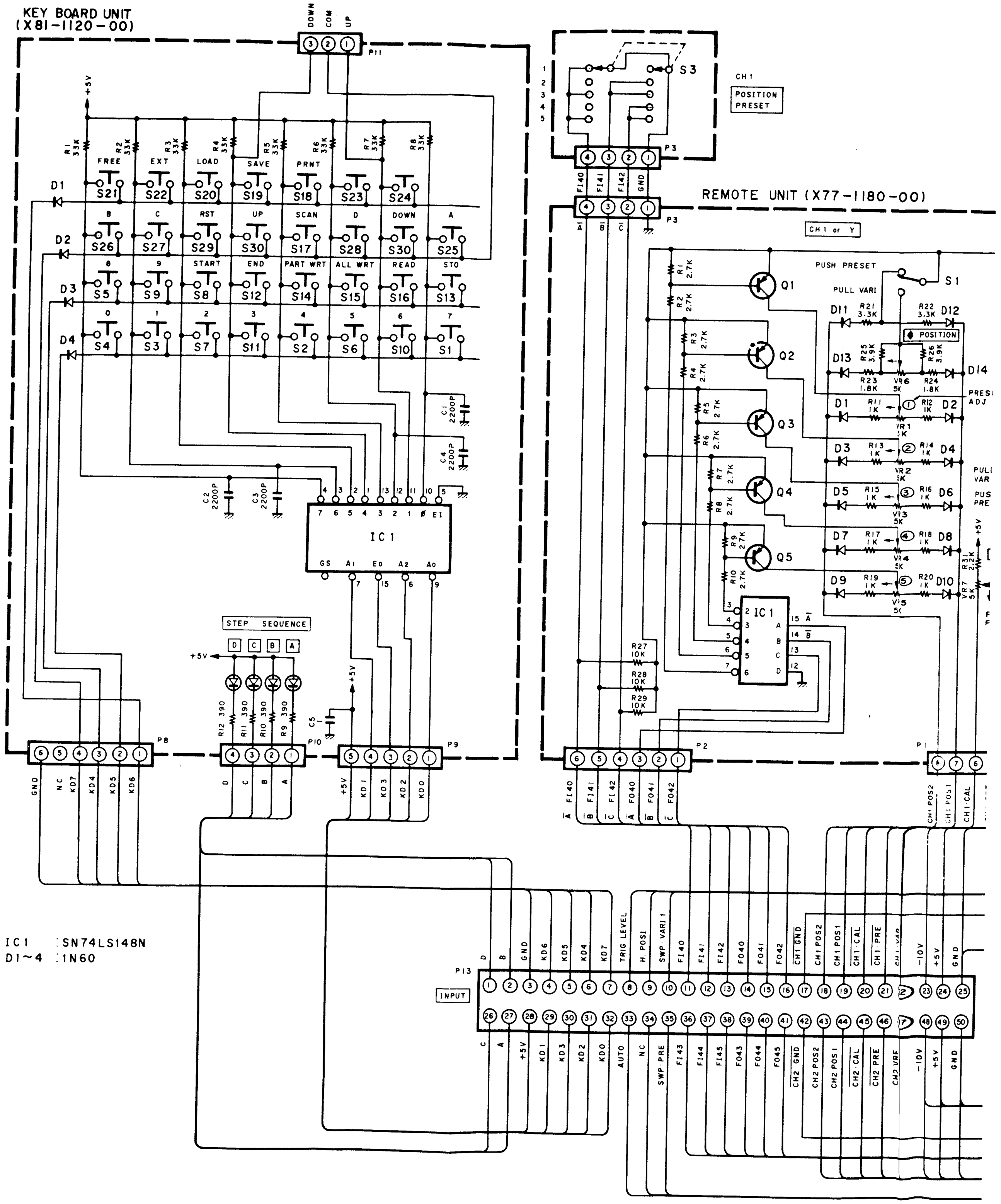
X81-1120-00


A
B
C
1
2
3
S1
S5
S9
S13
S17
S21
C1
S25
R9
S2
S6
S10
S14
S18
S22
C2
S26
R10
S3
S7
S11
S15
S19
S23
C3
S27
R11
S4
S8
S12
S16
S20
S24
C4
S28
R12
P8
D1
D4
D3
D2
R6
R7
R8
R5
R3
R1
R4
R2
C5
P11
IC1
P10
S29
S30
S31
P9
X81-1120-00

# WAVEFORM

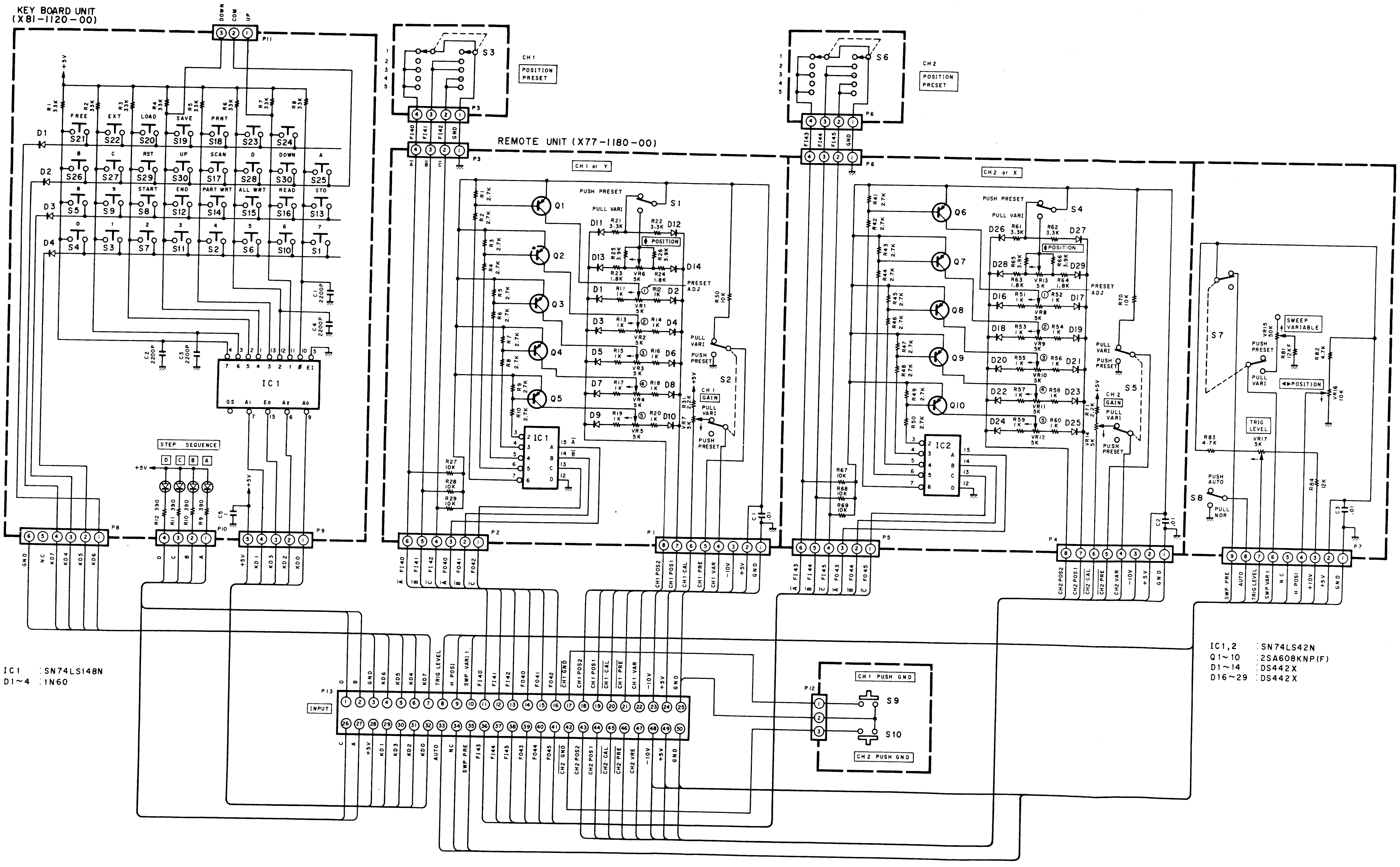
# SCHEMATIC DI

## RT-1721


KEY BOARD UNIT (X81-1120-00)
REMOTE UNIT (X77-1180-00)
P11 DOWN COM UP
FREE EXT LOAD SAVE PRNT
S21 S22 S20 S19 S18 S23 S24
B C RST UP SCAN D DOWN A
S26 S27 S29 S30 S17 S28 S30 S25
8 9 START END PART WRT ALL WRT READ STO
S5 S9 S8 S12 S14 S15 S16 S13
0 1 2 3 4 5 6 7
S4 S3 S7 S11 S2 S6 S10 S1
D1 D2 D3 D4
R1 33K R2 33K R3 33K R4 33K R5 33K R6 33K R7 33K R8 33K
C1 2200P C2 2200P C3 2200P C4 2200P C5
IC1
GS A1 E0 A2 A0 E1
STEP SEQUENCE
D C B A
R12 390 R11 390 R10 390 R9 390
+5V
P8 P9 P10
GND NC KD7 KD4 KD5 KD6
D C B A
+5V KD1 KD3 KD2 KD0
S3 CH1 POSITION PRESET
P3 FI40 FI41 FI42 GND
CH1 or Y
PUSH PRESET PULL VARI S1
Q1 Q2 Q3 Q4 Q5
R1 2.7K R2 2.7K R3 2.7K R4 2.7K R5 2.7K R6 2.7K R7 2.7K R8 2.7K R9 2.7K R10 2.7K
D11 R21 3.3K R22 3.3K D12
POSITION
D13 R23 1.8K VR6 R24 1.8K D14 R25 3.9K R26 3.9K
D1 R11 1K R12 1K D2 VR1 1K
D3 R13 1K R14 1K D4 VR2
D5 R15 1K R16 1K D6 VR3 5K
D7 R17 1K R18 1K D8 VR4 5K
D9 R19 1K R20 1K D10 VR5
PRESET ADJ
PULL VAR
PUSH PRE
IC1 A B C D
R27 10K R28 10K R29 10K
P2 P1
FI40 FI41 FI42 FO40 FO41 FO42
CH1 POS2 CH1 POS1 CH1 CAL
P13 INPUT
D B GND KD6 KD5 KD4 KD7 TRIG LEVEL H.POSI SWP VARI1 FI40 FI41 FI42 FO40 FO41 FO42 CH1 GND CH1 POS2 CH1 POS1 CH1 CAL CH1 PRE CH1 VAR -10V +5V GND
C A +5V KD1 KD3 KD2 KD0 AUTO NC SWP PRE FI44 FI45 FO43 FO44 FO45 CH2 GND CH2 POS2 CH2 POS1 CH2 CAL CH2 PRE CH2 VAR -10V +5V GND
IC1 : SN74LS148N
D1~4 : 1N60

# SCHEMATIC DIAGRAM

## RT-1721

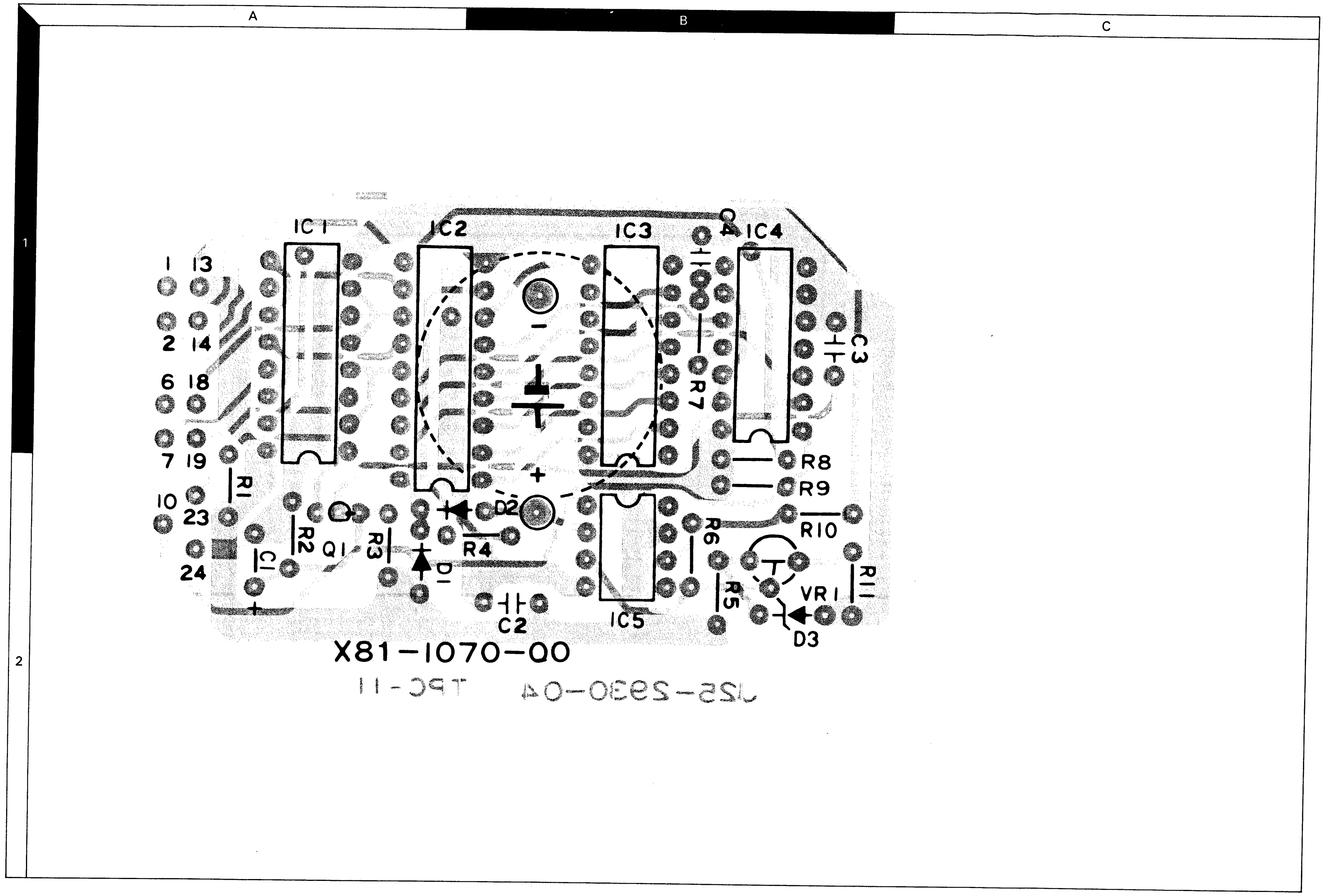

KEY BOARD UNIT
(X81-1120-00)
REMOTE UNIT (X77-1180-00)
CH1 POSITION PRESET
CH2 POSITION PRESET
CH1 or Y
CH2 or X
STEP SEQUENCE
D C B A
CH1 PUSH GND
CH2 PUSH GND
SWEEP VARIABLE
TRIG LEVEL
◀▶POSITION
♦ POSITION
PUSH PRESET
PULL VARI
PRESET ADJ
CH1 GAIN
CH2 GAIN
PUSH AUTO
PULL NOR
INPUT
IC1
IC2
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
P1
P2
P3
P4
P5
P6
P7
P8
P9
P10
P11
P12
P13
FREE
EXT
LOAD
SAVE
PRNT
START
END
PART WRT
ALL WRT
READ
STO
RST
UP
SCAN
DOWN
DOWN COM UP
GND NC KD7 KD4 KD5 KD6
D C B A
+5V KD1 KD3 KD2 KD0
F140 F141 F142 F040 F041 F042
CH1 POS2 CH1 POS1 CH1 CAL CH1 PRE CH1 VAR -10V +5V GND
F143 F144 F145 F043 F044 F045
CH2 POS2 CH2 POS1 CH2 CAL CH2 PRE CH2 VAR -10V +5V GND
SWP PRE AUTO TRIG LEVEL SWP VARI NC H. POSI +10V +5V GND

IC1 : SN74LS148N
D1~4 : 1N60

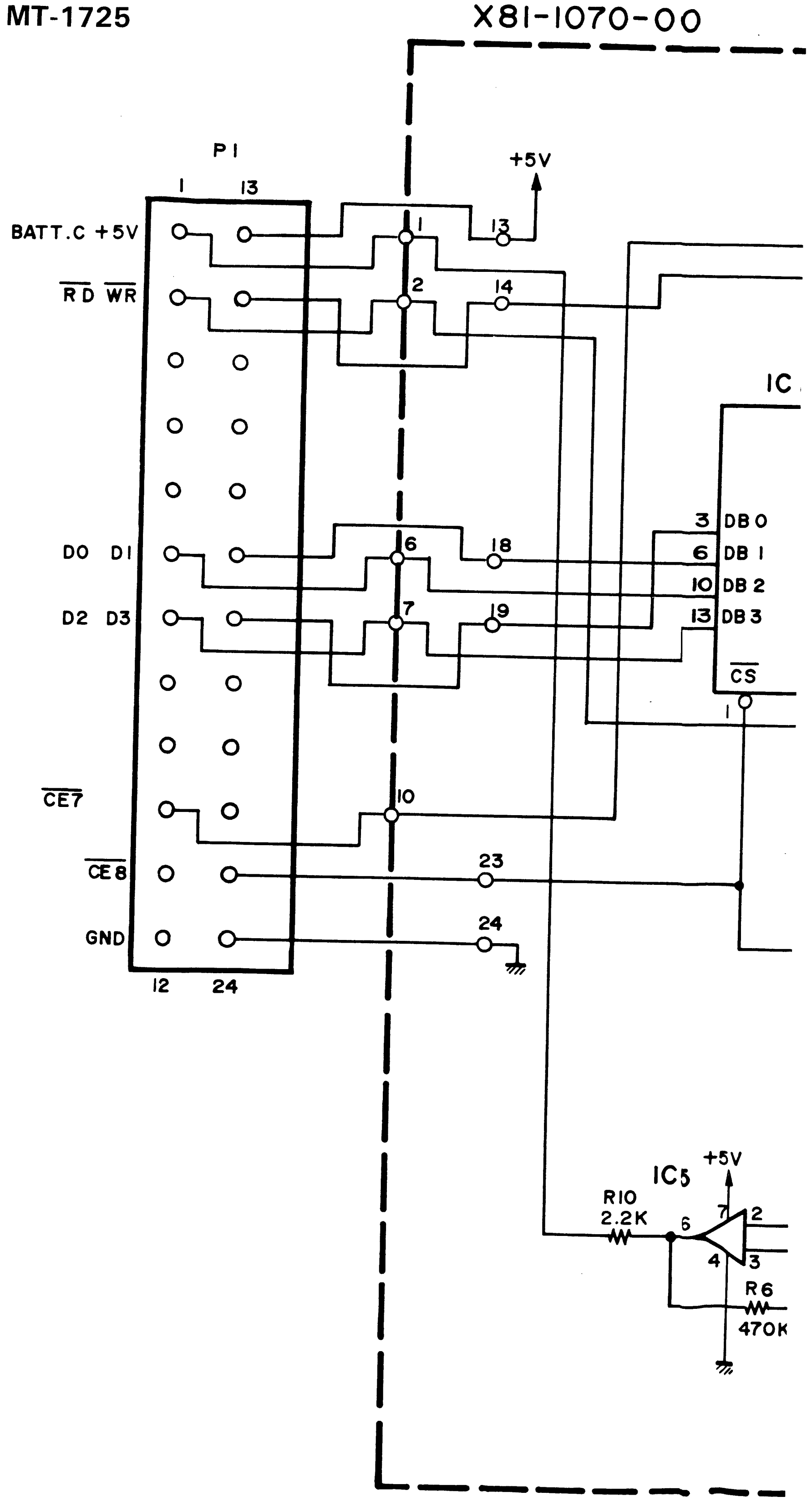
IC1,2 : SN74LS42N
Q1~10 : 2SA608KNP(F)
D1~14 : DS442X
D16~29 : DS442X

# P.C. BOARD

**X81-1070-00**



A
B
C
1
2
IC1
IC2
IC3
IC4
IC5
1 13
2 14
6 18
7 19
10 23
24
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
C1
C2
C3
Q1
D1
D2
D3
VR1
X81-1070-00

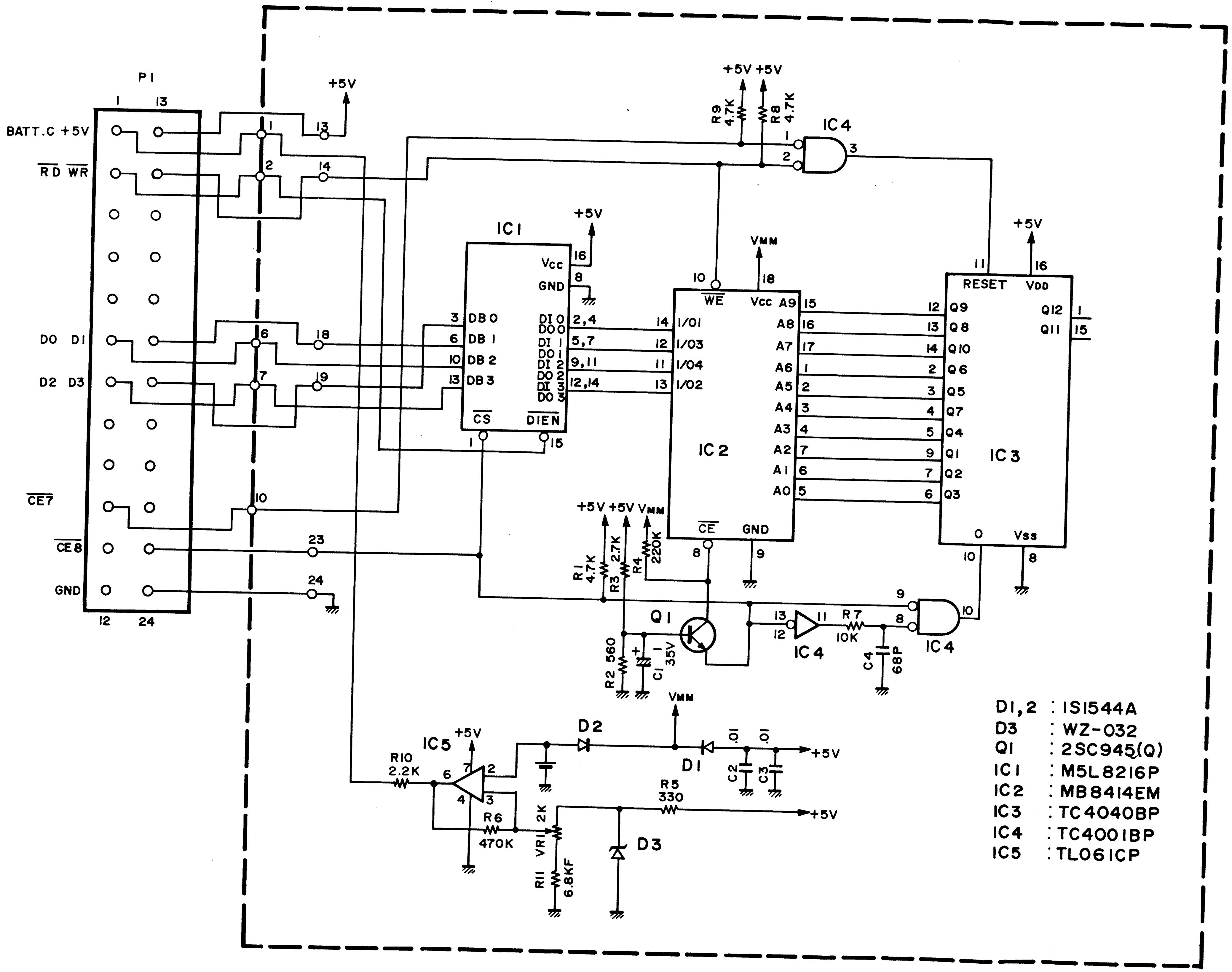


MT-1725
X81-1070-00
P1
1
13
BATT.C +5V
RD WR
D0 D1
D2 D3
CE7
CE8
GND
12
24
+5V
1
13
2
14
6
18
7
19
10
23
24
IC
3 DB0
6 DB1
10 DB2
13 DB3
CS
1
IC5
+5V
R10
2.2K
6
7
2
4
3
R6
470K

# SCHEMATIC DIAGRAM

C

MT-1725


X81-1070-00
P1
1
13
12
24
BATT.C +5V
RD WR
D0 D1
D2 D3
CE7
CE8
GND
+5V
IC1
Vcc
GND
DB0
DB1
DB2
DB3
DI 0
DO 0
DI 1
DO 1
DI 2
DO 2
DI 3
DO 3
CS
DIEN
IC2
WE
Vcc
A9
A8
A7
A6
A5
A4
A3
A2
A1
A0
I/O1
I/O3
I/O4
I/O2
CE
GND
VMM
IC3
RESET
VDD
Q12
Q11
Q9
Q8
Q10
Q6
Q5
Q7
Q4
Q1
Q2
Q3
0
Vss
IC4
R9 4.7K
R8 4.7K
R1 4.7K
R3 2.7K
R4 220K
R2 560
C1 1 35V
Q1
R7 10K
C4 68P
IC5
R10 2.2K
R6 470K
VR1 2K
R11 6.8KF
D1
D2
D3
R5 330
C2 .01
C3 .01

D1,2 : 1S1544A
D3 : WZ-032
Q1 : 2SC945(Q)
IC1 : M5L8216P
IC2 : MB8414EM
IC3 : TC4040BP
IC4 : TC4001BP
IC5 : TL061CP

# SEMICONDUCTORS

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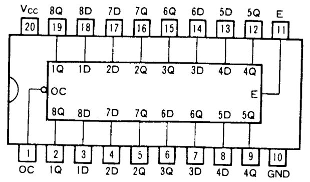
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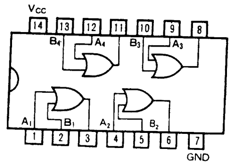
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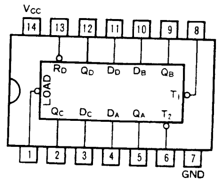
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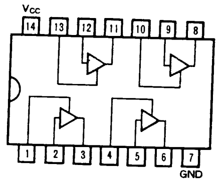
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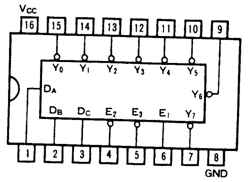
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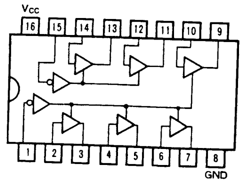
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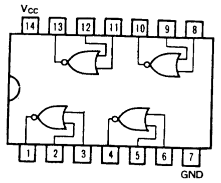
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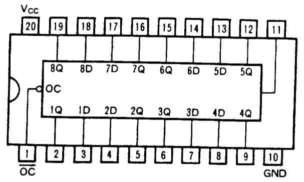
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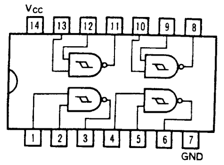
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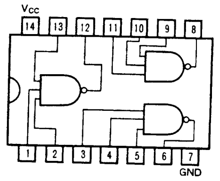
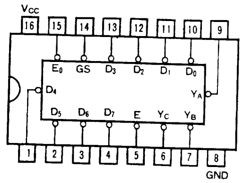
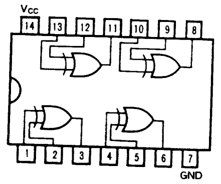
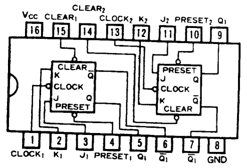

SN74LS10N


SN74LS148N


SN74LS86N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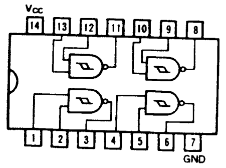
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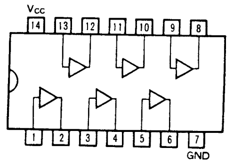
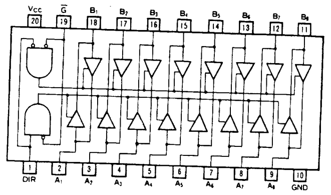
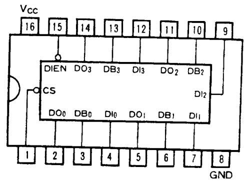
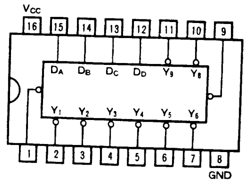
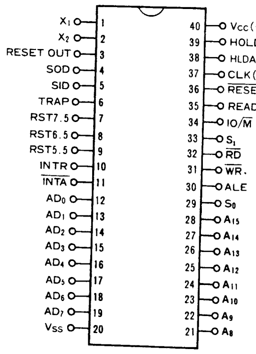

SN7407N


MB74LS245

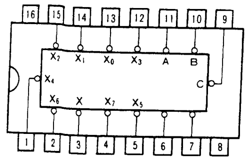

M5L8216P

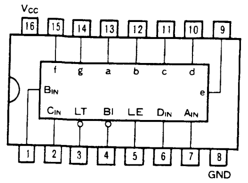

SN74LS42N

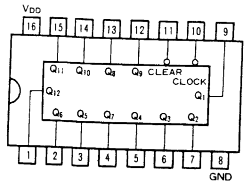
## N MOS

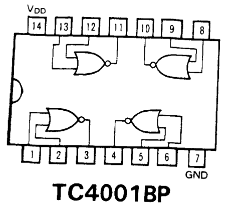

X1 1
X2 2
RESET OUT 3
SOD 4
SID 5
TRAP 6
RST7.5 7
RST6.5 8
RST5.5 9
INTR 10
INTA 11
AD0 12
AD1 13
AD2 14
AD3 15
AD4 16
AD5 17
AD6 18
AD7 19
Vss 20
40 Vcc(+5V)
39 HOLD
38 HLDA
37 CLK(OUT)
36 RESET IN
35 READY
34 IO/M
33 S1
32 RD
31 WR
30 ALE
29 S0
28 A15
27 A14
26 A13
25 A12
24 A11
23 A10
22 A9
21 A8
μP-D8085AC

## C MOS

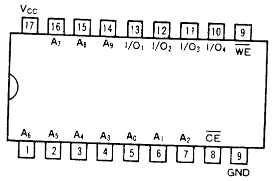

M14051BCP


TC4511BP

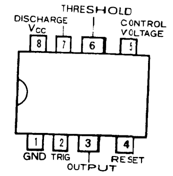

TC4040BP

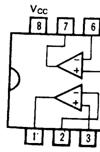

TC4001BP

## C MOS RAM

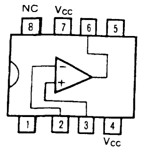

MB8414EM

## TIMER


THRESHOLD
DISCHARGE
Vcc
CONTROL VOLTAGE
GND
TRIG
OUTPUT
RESET
NJM555D

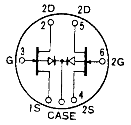

NJM45

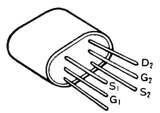
## OP AMP

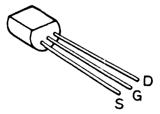


TL061CP

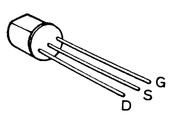
## FET


2D
2D
1G
2G
1S
CASE
2S
μPA70A (L)


D2
G2
S2
S1
G1
D1
2SK228T (2, 3)

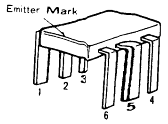


2SK30A (O)
2SK68A (M)
2SK107 (2, 3)

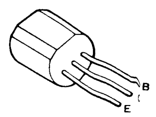


2SK19 (BL)

## TRA


Emitter Mark
2SA884
2SC1963

2SA9
2SC8

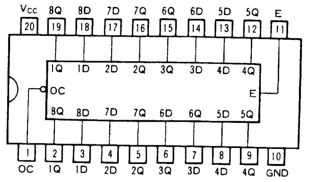


2SA1208
2SC2910 (S, T)

2SA608KN
2SA838 (C)
2SA684
2SC2910

# SEMICONDUCTORS

## TTL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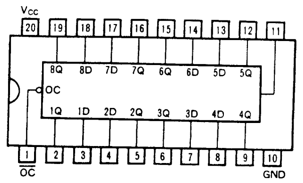
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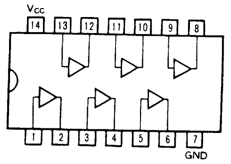
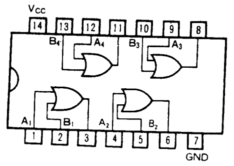

SN7407N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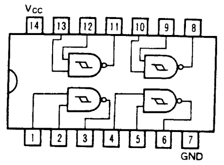
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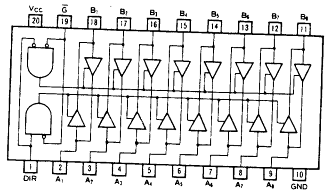
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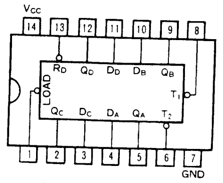
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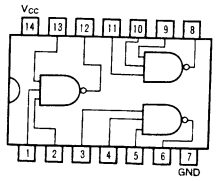
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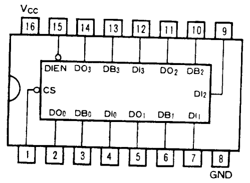
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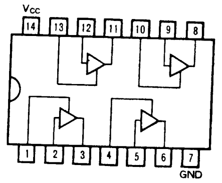
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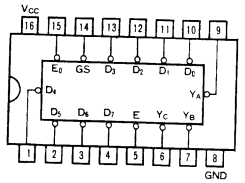
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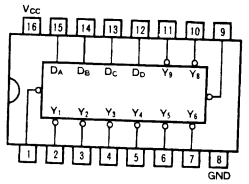
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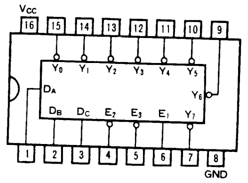
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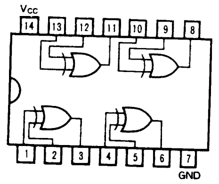
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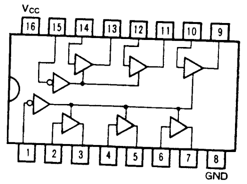
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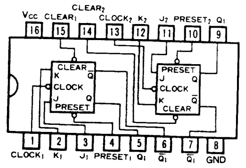
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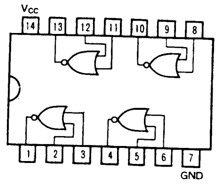
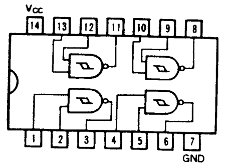

M74LS02P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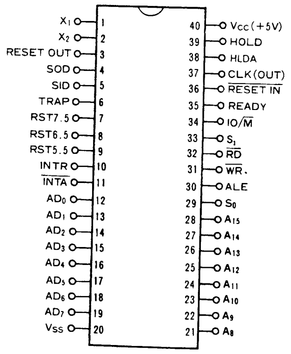
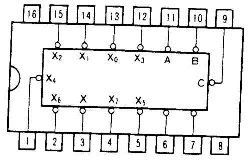
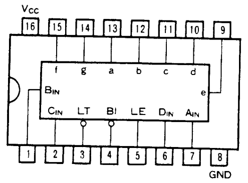
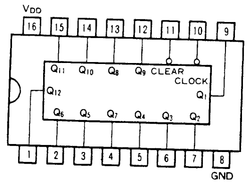
## N MOS

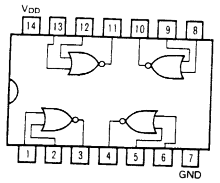

X₁ 1
X₂ 2
RESET OUT 3
SOD 4
SID 5
TRAP 6
RST7.5 7
RST6.5 8
RST5.5 9
INTR 10
INTA 11
AD₀ 12
AD₁ 13
AD₂ 14
AD₃ 15
AD₄ 16
AD₅ 17
AD₆ 18
AD₇ 19
Vss 20
40 Vcc(+5V)
39 HOLD
38 HLDA
37 CLK(OUT)
36 RESET IN
35 READY
34 IO/M
33 S₁
32 RD
31 WR
30 ALE
29 S₀
28 A₁₅
27 A₁₄
26 A₁₃
25 A₁₂
24 A₁₁
23 A₁₀
22 A₉
21 A₈
μP-D8085AC

## C MOS

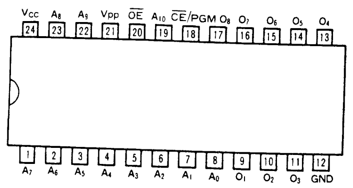

M14051BCP


TC4511BP

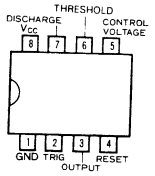

TC4040BP

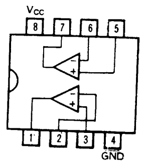

TC4001BP

## P ROM


MB8516ZC

## TIMER


THRESHOLD
DISCHARGE
Vcc
CONTROL VOLTAGE
GND
TRIG
OUTPUT
RESET
NJM555D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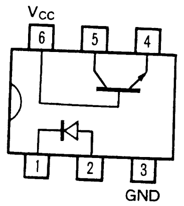
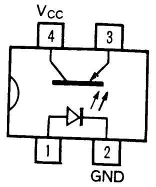
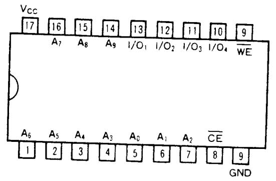


ON3101

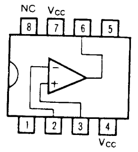


TLP521-1

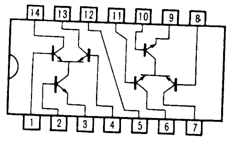
## C MOS RAM


MB8414EM

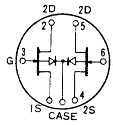
## OP AMP

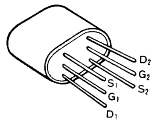

TL061CP

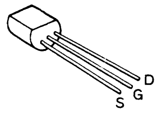
## OTHER


CA3102E

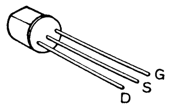
## FET


2D
2D
1G
2G
1S
CASE
2S
μPA70A (L)


D₂
G₂
S₂
S₁
G₁
D₁
2SK228T (2, 3)

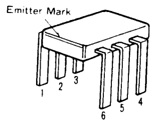


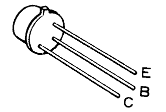
2SK30A (O)
2SK68A (M)
2SK107 (2, 3)



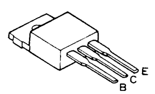
2SK19 (BL)

## TRANSISTOR

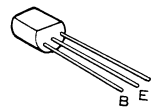

Emitter Mark
2SA884
2SC1963



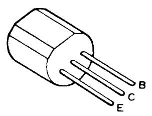
2SA923−2−2 or 3
2SC805A2−2 or 3



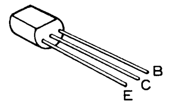
2SB633 (E)
2SC1505 (L)
2SD613 (E)



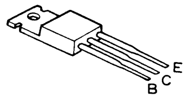
2SC945



2SA1208
2SC2910 (S, T)



2SA608KNP (F) 2SC536KNP (F)
2SA838 (C) 2SC1047 (C)
2SA684 2SC1215 (Tors)
2SC2910 2SC1973 (T)



2SC1019 (Q, R)
2SC1913 (Q, R)